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GUIDE
TO
PHYSICAL DIAGNOSIS
BY
E. M. MAGRUDER.

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GUIDE

TO

PHYSICAL DIAGNOSIS

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PREFACE.

The various methods of physical examination and the results obtained by their employment are dependent upon and explained by certain physical laws which are, or ought to be, familiar to all; and my purpose has been to demonstrate this dependence, to condense and systematize the theory of Physical Diagnosis, and to show its practical application in disease.

It is intended not to substitute more comprehensive works, but to aid in their study and assimilation; and it is likewise hoped that an easy and rapid means of review will be placed at the disposal of the overtaxed student and busy physician. Claim is made not for originality of ideas, but for originality in the massing, condensation, and systematic arrangement of the teachings of authorities in the different branches of medicine involved herein.

In the preparation of this little volume I have followed the instruction, in Anatomy, of

Davis, Towles, Christian, Gray, Treves, and Cunningham;

Physiology, of

Cabell, Barringer, and Landois; and

Physical Diagnosis, of

Page, DaCosta, Buckmaster, Strümpell, Osler, Quain, Porter, and J. S. Davis, Jr.

Dr. R. C. M. Page's excellent work on Physical Diagnosis has served as the basis in the preparation of this, and from it numerous extracts have been made *verbatim*. Especial attention is called to the diagrams illustrating the different varieties of respiration.

These are the valuable invention of the same great teacher and impart an impetus to the grasp of the subject equalled by no other method of teaching it.

With the foregoing apology, I modestly and anxiously submit the result of my labors to the charitable consideration of an indulgent profession, in the full confidence that what is good will be commended and what is indifferent will be excused.

E. M. MAGRUDER, M. D.,
Charlottesville, Va.

April, 1897.

REGIONAL ANATOMY

CONCERNED WITH

PHYSICAL DIAGNOSIS.

The regions of the human body for physical examination are: The head, the neck, the chest, the abdomen, the pelvis, and the extremities (upper and lower).

THE HEAD.

The parts of the *Head* for examination are:

The shape, the size, the hair, the scalp, the cranium, the fontanelles (anterior and posterior), the forehead, the face, the eyes and their appendages (the eyebrows, the lashes, the lids, the balls, the conjunctivae, the cornea, the sclera, the pupils, the iris, the retina, the lens, the anterior and posterior chambers, the ciliary muscle, the arteria centralis retinae, &c.), the nose (the mucous membrane, the play of the nostrils, the turbinated bones, &c.), the chin, the mouth and its appendages [the lips, the teeth, the gums, the mucous membrane, the tongue (shape, size, color, coating, edges, papillae, &c.), the palate (hard and soft), the uvula. the fauces, the tonsils, the third tonsil, the pharynx, the antrum, Steno's duct, &c.], the ears (the pinna, the auditory canal, the membrana tympani, the middle ear, the eustachian tube, the internal ear, &c.), &c.

THE NECK.

The parts of the *Neck* for examination are:

The shape, the size, the skin, the larynx (the epiglottis, the rima glottidis, the vocal cords, the cartilages,

the laryngeal muscles, &c.), the trachea, the muscles, the lymphatic glands, the blood-vessels, the sterno-clavicular articulation, the supra-clavicular fossae, the supra-sternal fossa, &c.

THE CHEST.

The parts of the *Chest* for examination are :

The shape, the size, the skin, the movements (expansion and contraction), the apex beat of the heart, the axillae, the vertical lines, the regions and their contents, &c.

THE VERTICAL LINES OF THE CHEST.

(Page.)

(1) *The Anterior Median Line* runs vertically through the middle of the Sternum.

(2) *The Sternal Lines*, right and left, run vertically by the sides of the Sternum and close to it.

(3) *The Parasternal Lines*, right and left, run vertically midway between the Sternum and the nipple.

(4) *The Mammillary Lines*, right and left, run vertically through the nipple.

(5) *The Anterior Axillary Lines*, right and left, run vertically downward in front from the inner end of the outer fourth of the clavicle.

(6) *The Axillary Lines*, right and left, run vertically through the middle of the axilla.

(7) *The Posterior Axillary Lines*, right and left, run vertically downward behind from the inner end of the outer fourth of the clavicle.

(8) *The Scapular Lines*, right and left, run vertically through the inferior angle of the scapula.

(9) *The Vertebral Lines*, right and left, run vertically by the sides of the vertebral column and close to it.

(10) *The Posterior Median Line* runs vertically up and down the middle of the spinal column.

THE REGIONS OF THE CHEST AND THEIR CONTENTS.

(Page).

I. In front.

(1) *The Supra-clavicular Region* (one on each side). This is triangular and bounded as follows:

Below, by the upper border of the clavicle (its inner three-fourths):

Internally, by the outer edge of the sterno-cleido-mastoid muscle;

Externally, by a line drawn from the inner end of the outer fourth of the clavicle to a point on the sterno-mastoid muscle corresponding to the upper ring of the trachea:

The contents of this region on both sides are the apex of the lung which rises 1½ inches into the neck.

(2) *The Clavicular Region* (one on each side).

This corresponds to the inner ¾ of the clavicle and contains lung on both sides.

(3) *The Subclavicular Region* (one on each side). This is quadrilateral and bounded as follows:

Above, by the lower border of the clavicle:

Below, by the upper border of the 3d costal cartilage and rib (corresponding with the base line of the heart):

Internally, by the edge of the sternum (sternal line):

Externally, by a vertical line let fall in front from the inner end of the outer fourth of the clavicle. This line is continuous below with the anterior axillary line.

The contents of this region on both sides are lung tissue chiefly; but on the right side there is

also the right primitive bronchus which causes some modification in the physical signs.

Note. In order to find the 3rd rib, or any rib, feel for the horizontal ridge on the sternum that marks the junction of the manubrium and gladiolus. At each end of this ridge is the junction of the 2d costal cartilage with the sternum, and below it is the 3rd costal cartilage, and so on. The right and left second intercostal spaces, called respectively the "aortic" and "pulmonic interspaces," are of especial interest in the study of heart murmurs.

(4) *The Mammary Region* (one on each side). This is quadrilateral and bounded as follows:

Above, by the upper border of the 3d rib and costal cartilage:

Below, by the upper border of the 6th rib and costal cartilage. (This corresponds on the right side with the upper limit of "hepatic dullness" and lower limit of "pulmonary resonance":

Internally, by the edge of the sternum (sternal line):

Externally, by the anterior axillary line which is continuous with the outer boundary of the region above.

The contents of this region are, on the right side lung, and on the left the heart with some lung tissue. The left mammary region contains most of the "superficial area of cardiac dullness."

(5) *The Submammary Region* (Hypochondriac Region) (one on each side). This appears triangular, but really has four sides, and is bounded as follows:

Above, by the upper border of the 6th rib and costal cartilage.

Below, by the free margin of the ribs.

Internally, by the edge of the sternum, where it almost comes to a point.

Externally, by the lower part of the anterior axillary line, which here corresponds to the anterior border of the spleen from the 9th to the 11th rib.

The contents of this region are, on the right side the right lobe of the liver, and on the left the left lobe of the liver and large end of the stomach.

Between the two submammary regions is the epigastric region.

(6) *The Supra-Sternal Region* (in the middle line). This is quadrilateral, lying between the two supra-clavicular regions, and bounded as follows :

Above, by a line drawn across the upper ring of the trachea joining the two supra-clavicular regions :

Below, by the upper end of the sternum :

On each side, by the inner boundaries of the two supra-clavicular regions, *i. e.*, the sterno-cleido-mastoid muscle.

The contents of this region are the trachea and large blood vessels ; but by firm pressure downward with the finger, the patient's head being inclined forward, pulsations of the transverse aorta may be felt, especially in the case of an aneurism.

(7) *The Superior Sternal Region* (in the middle line). This is quadrilateral and corresponds to that part of the sternum above the 3d costal cartilages.

The contents of this region are the lower part of the trachea, the two primitive bronchi, and the anterior edge of the right lung.

(8) *The Inferior Sternal Region* (in the middle line). This has the shape of the lower part of the ster-

num and corresponds to that part of the sternum below the upper border of the 3d costal cartilages.

The contents of this region are a small part of the heart above and of the liver below, and the anterior edge of the right lung as far as the 6th costal cartilages.

II. Behind :

(1) *The Supra-scapular Region* (one on each side). This is triangular and corresponds to the supra-spinous fossa of the scapula.

Its contents are lung tissue on both sides.

(2) *The Scapular Region* (one on each side).

This is quadrilateral and corresponds to the infra-spinous fossa of the scapula taking in at its lower inner angle a part of the adjacent region so as to make it four-sided. This region extends down to the 8th rib.

Its contents are lung tissue on both sides.

(3) *The Inter-scapular Region* (in the middle line).

This is situated between the two scapulae and is divided by the spinal column into the Right and Left Inter-scapular Regions. It extends from a line joining the upper angle of the two supra-scapular regions above downward to a line joining the lower angles of the two scapular regions below (which corresponds to the upper border of the 8th ribs).

Its contents are the two primitive bronchi, which enter the lungs opposite the 4th and 5th dorsal vertebrae on the right and left sides respectively, and some lung tissue.

(4) *The Subscapular Region* (one on each side).

This is quadrilateral and bounded as follows : Above, by the lower borders of the scapular

and inter-scapular regions, (upper border of the 8th ribs):

Below, by the lower border of the 12th ribs:

Internally, by the spinal column:

Externally, by the posterior axillary line (which is a vertical line let fall behind from the inner end of the outer fourth of the clavicle).

Its contents are, on the right side the right lobe of the liver, and on the left side intestine (if distended) and spleen (if enlarged).

III. Laterally:

(1) *The Axillary Region* (one on each side). This corresponds to the axilla and is bounded as follows:

Above, this region terminates in the axilla:

Below, by a line connecting the lower border of the mammary with the lower border of the scapular region. This corresponds to about the 7th intercostal space which is thus cut obliquely:

In front, by the anterior axillary line:

Behind, by the posterior axillary line:

The contents of both regions are lung tissue.

(2) *The Subaxillary Region* (one on each side). This is quadrilateral and bounded as follows:

Above, by the lower border of the axillary region (corresponding to the 7th intercostal space cut obliquely):

Below, by the lower border of the 12th rib:

In front, by the lower part of the anterior axillary line.

Behind, by the lower part of the posterior axillary line.

Its contents are, on the right side the liver, and on the left the spleen and large end of the stomach.

REGIONAL ANATOMY OF THE THORACIC ORGANS.

THE TRACHEA.

The trachea is about 4½ inches long and ¾ inch in diameter. It begins at the lower border of the cricoid cartilage opposite the disk between the 5th and 6th cervical vertebrae and divides opposite the junction of the manubrium and gladiolus in front and 4th dorsal vertebra behind, into the two primitive bronchi, right and left (Christian).

THE PRIMITIVE BRONCHI.

The right bronchus, 1 inch long, larger, shorter, more horizontal, and more superficial in front than the left, enters the right lung just behind the upper border of the 3d right costal cartilage and opposite the lower border of the 4th dorsal vertebra (Page and Christian).

The left bronchus, nearly 2 inches long, smaller, longer, more oblique, and more deeply seated in front than the right, passes under the transverse aorta crossing the front of the descending aorta and enters the left lung opposite the 5th dorsal vertebra 1 inch lower down than the right (Christian).

The septum between the two bronchi at their bifurcation is to the left of the middle line, so that foreign bodies are more apt to fall into the right bronchus.

THE LUNGS.

The lungs are situated one in each of the lateral cavities of the chest, separated from each other by the heart and other contents of the mediastinum. The shape of the lungs is conical, the apex being above and the base below.

The right lung is larger, broader (owing to the inclination of the heart to the left side), and 1 inch shorter (on account of the large right lobe of the liver under it) than the left, and has 3 lobes.

The left lung is smaller, narrower, and longer than the right, and has 2 lobes.

The apex of the lung extends upwards into the root of the neck for 1½ inches above the 1st rib; but in persons with long necks as much as 2 inches. It also extends higher in women than in men. It is covered in front by the sterno-mastoid, sterno-hyoid, sterno-thyroid, and scalenus anticus muscles, and lies below and behind the subclavian vessels.

The apex of the lung is peculiarly liable to tuberculosis (especially the left apex).

The base of the lung rests upon the diaphragm, the right having under it the right lobe of the liver, and the left having under it the left lobe of the liver, the stomach, the spleen, and the splenic flexure of the colon. It extends lower down externally and behind than in front. Its circumference is thin and fits into the space between the lower ribs and costal attachment of the diaphragm; but it is doubtful if it ever reaches the lowest limit of this recess. During respiration the lungs remain in close apposition with the walls of the cavity in which they lie, rising and falling during respiration.

The base of the lung is peculiarly liable to acute lobar pneumonia (especially the right base).

The anterior borders of the lungs lie behind the sterno-clavicular articulations, pass obliquely downward behind the manubrium, and nearly meet in the middle line behind the junction of the manubrium with the gladiolus on a level with the 2d costal cartilages, the pleurae and fascia intervening. So there is not much lung tissue behind the manubrium.

The edge of the right lung then continues vertically downwards behind the median line of the sternum to the 6th costal cartilage, where it slopes off along the line of the 6th right costal cartilage and rib. (Treves.)

The edge of the left lung passes down behind the left edge of the sternum, keeping close to that of the right, as far as the 4th costal cartilage, where it turns off to the left, following the line of the 4th costal cartilage and then a line drawn from this cartilage to the apex of the heart. The two edges in no place come in contact; the right reaches the median line of the sternum, but the left only reaches the left edge of the sternum (Treves).

In children, owning to the thymus gland, the edges are more separated in front (Treves).

These two margins then, becoming the lower margins of the lungs, correspond to a line drawn downwards, outwards and backwards, from the 6th chondrosternal articulation in front to the 11th dorsal spine behind. (There is a gap of course in this line on the left between the median line of the sternum and the apex of the heart occupied by the heart.)

In the Vertical Lines of the chest then the lungs descend to the following points:

In the Sternal Lines as low as the 6th costal cartilage on the right and the 4th costal cartilage on the left;

In the Mammillary Lines as low as the upper border of the 6th rib (Treves):

In the Axillary Lines as low as the 8th rib on the right and 9th rib on the left (Treves):

In the Scapular Lines as low as the 10th rib (Treves):

During a deep inspiration the margins descend 1½ inches farther (Gray).

The pleura extends farther down than the lung, reaching—

In the Sternal Lines the 7th costal cartilage on the right, and 4th costal cartilage on the left;

In the Mammillary Lines about the 7th costal cartilage;

In the Axillary Lines the 10th rib (Cunningham) or a point 2½ inches above the lower margin of the thorax (Treves);

In the Scapular Lines the 11th rib;

In the Vertebral Lines the 12th rib (Cunningham) or 11th dorsal spine (Treves).

The pleura extends lower down in children than in adults, reaching, behind, the 12th ribs.

THE HEART.

The size of the heart is *about* that of the closed fist, or, on an average, about 5x3½x2½ inches. Its shape is conical and it is a hollow muscle. It weighs in the adult female 8 to 10 oz., and in the adult male 10 to 12 oz.

The normal heart is situated obliquely inside the thorax a quarter of an inch behind the sternum, one third of the organ being to the right of the median line of that bone and two-thirds to the left of that line (Cunningham).

It has behind it the 4 middle dorsal vertebrae, i. e., the 5th, 6th, 7th and 8th, and in front of it the 3d, 4th, and 5th costal cartilages of the right side and the 3d, 4th, 5th and 6th costal cartilages of the left side (Cunningham).

The heart continues to increase in size and weight to an advanced period of life.

The base, directed upwards, backwards, and to the right, is after death on a level with the upper border of the 3d costal cartilages, extending ½ inch to the right and 1 inch to the left of the two edges of the sternum respectively. During life, however, the whole heart is situated higher in the chest cavity, on account of the distention of the heart and thoracic blood vessels with blood, which raises them higher up. The base then

corresponds with an oblique line drawn from the 1st left to the 2d right intercostal space (Porter).

The apex, directed downwards, forwards, and to the left, strikes the chest wall in the 5th intercostal space 2 inches below and 1 inch within the left nipple; or, as more recently given, at a point 3 to 3½ inches horizontally to the left of the middle of the sterno-xiphoid articulation (Towles and Porter) (and 1½ inches below the nipple).

OUTLINE OF THE HEART.

(Treves and Page.)

The "base line" of the heart corresponds to a line drawn across the sternum on a level with the upper border of the 3d costal cartilages ½ inch to the right and 1 inch to the left of the sternum (or 1½ inches to the right and 2½ to 3 inches to the left of the median line of the sternum).

The left border extends from the left end of the base line to the apex, curving outwards.

The lower border extends from the apex horizontally to the right to the middle of the sterno-xiphoid articulation, curving somewhat downwards.

The right border extends from the middle of the sterno-xiphoid articulation upward and to the right to the right end of the base line, curving somewhat outwards.

A part of the anterior aspect of the heart is always covered by lung tissue, to a greater extent during inspiration and to a less extent during expiration. But a considerable part of the anterior aspect is always uncovered by the lungs.

The uncovered portion of the heart is somewhat triangular and begins above by an acute angle in the median line of the sternum about opposite the 4th cos-

tal cartilages (where the anterior border of the left lung begins to diverge from the right) running downward and to the left towards the apex, so that it is the lower part of the right ventricle and apex of the left ventricle that is uncovered. It is now being taught that the left auricle is the lowest part of the heart instead of the right;—consequently

The Left Auriculo-ventricular Axis is represented by a line drawn from the 8th dorsal vertebra behind, forward, upward, and to the left, to the 4th left costo-chondral articulation; hence the normal current of blood must follow in the main this direction, from left auricle to left ventricle (Porter).

The Right Auriculo-ventricular Axis is represented by a line drawn from the junction of the right posterior axillary line with the 4th right intercostal space behind, downward, forward, and to the left, to the junction of the 5th left costal cartilage with the sternum in front. This line passes almost through the centre of the right lung (Porter).

SITUATION OF THE CARDIAC VALVES.

The Pulmonary Valve (three segments), the highest up in the chest and the most superficial (nearest to the front), is situated behind the junction of the 3d left costal cartilage with the sternum (Page & Gray).

The Aortic Valve (three segments) is situated behind the left edge of the sternum on a level with the lower border of the 3d left costal cartilage (Page & Gray).

The Mitral Valve (two segments), the deepest (i. e., the farthest from the front) and farthest to the left, is situated behind the 3d left intercostal space one inch from the left edge of the sternum (Towles & Gray).

The Tricuspid Valve (three segments), the lowest

down and the farthest to the right, is situated behind the middle of the sternum, on a level with the 4th costal cartilages (Page & Gray).

A circle 1 inch in diameter, it is said, will include parts of all these valves.

THE GREAT VESSELS.

(Page & Gray).

The Pulmonary Artery, 2 inches long, begins behind the junction of the 3d left costal cartilage with the sternum, runs upward and to the left across the 2d left intercostal space (pulmonic interspace), and terminates behind the junction of the 2d left costal cartilage (pulmonic cartilage) with the sternum (Page).

The Ascending Aorta begins behind the left edge of the sternum on a level with the lower border of the 3d left costal cartilage, passes upward and to the right a little beyond the right edge of the sternum, across the 2d right intercostal space (aortic interspace), and terminates behind the right edge of the sternum, on a level with the upper border of the 2d right costal cartilage (aortic cartilage). A needle passed through the aortic interspace close to the sternum would puncture the aorta.

The Transverse Aorta begins behind the right edge of the sternum on a level with the upper border of the 2d right costal cartilage, passes backward and to the left, the under surface of the arch being opposite the junction of the manubrium with the gladiolus, and terminates at the left side of the lower border of the 4th dorsal vertebra;—thence

The Descending Aorta passes on downward by the left side of the 5th dorsal vertebra to its termination. (This accounts for the fact that the aortic obstructive murmur is transmitted so as to be heard behind over the 4th & 5th dorsal vertebrae).

THE ABDOMEN.

The parts of the *Abdomen* for examination are :—

The skin, the shape, the size, the movements, the distention, McBurney's Point, the regions and their contents, &c.

MCBURNEY'S POINT.

Draw a line from the anterior superior spine of the right ilium to the umbilicus. McB's Point is a point on this line from 3 to 3½ inches from the former and corresponds to the usual position of the appendix.

THE REGIONS OF THE ABDOMEN AND THEIR CONTENTS.

The Abdomen is divided into nine regions by the following lines :

(1) *Two circular parallel lines* drawn around the body, the one parallel and on a level with the 9th costal cartilages, and the other on a level with the crests of the ilia at their highest points. The Abdomen is thus divided into 3 horizontal zones, one above the other.

(2) *Two vertical parallel lines* drawn straight upward from the centre of Poupart's ligament (to the 8th costal cartilage). These divide the Abdomen into three vertical zones which cut the three horizontal zones, forming 9 regions.—

These nine regions are as follows :—

(1) *The Epigastric Region*, situated in the middle of the upper horizontal zone.

Its contents are the middle and pyloric end of the stomach, the left lobe of the liver, and the pancreas.

(2) *The Right Hypochondriac Region*, situated to the right of the epigastric region and corresponding to the submammary region of the chest.

Its contents are the right lobe of the liver, the gall bladder, the duodenum, the right end of the

pancreas, the hepatic flexure of the colon, the upper end of the kidney, and the supra-renal capsule (the right end of the stomach).

(3) *The Left Hypochondriac Region*, situated to the left of the epigastric region and corresponding to the left submammary region.

Its contents are the large end of the stomach, the spleen, the tail of the pancreas, the splenic flexure of the colon, the upper end of the kidney, and the supra-renal capsule (the left end of the liver).

(4) *The Umbilical Region*, situated in the middle of the middle horizontal zone.

Its contents are the transverse colon, the great omentum, the mesentery, the duodenum, jejunum, and ilium.

(5) *The Right Lumbar Region*, situated to the right of the umbilical region.

Its contents are the ascending colon, the lower part of the kidney, and the convolutions of the small intestine.

(6) *The Left Lumbar Region*, situated to the left of the umbilical region.

Its contents are the descending colon, the omentum, the lower part of the kidney, and the convolutions of the small intestine.

(7) *The Hypogastric (Pubic) Region*, situated in the middle of the lower horizontal zone.

Its contents are the convolutions of the small intestine, the bladder (in children always, and in adults when distended), and the uterus during pregnancy.

(8) *The Right Inguinal Region*, situated to the right of the hypogastric region.

Its contents are the caecum, the vermiform appendix, and the ureter.

(9) *The Left Inguinal Region*, situated to the left of the hypogastric region.

Its contents are the sigmoid flexure of the colon and the ureter.

REGIONAL ANATOMY OF THE ABDOMINAL ORGANS.

THE LIVER.

The liver lies beneath the diaphragm and above part of the stomach, and is situated in the right hypochrondriac and epigastric regions and extends into the left hypochondriac regions 1½ inches to the left of the sternum (Treves), [as far as the mammillary line, (Gray)]. Its size is about 12x6x3 inches, and its weight is 3 or 4 lbs.

The upper and lower limits of the liver respectively are :

In the Left Parasternal Line the level of the 6th chondro-sternal articulation above (Quain and Treves) and the level of the lower border of the 6th rib below (?).

In the Sternal Lines, the lower end of the gladiolus above and a point ¼ way between the ensiform cartilage and the umbilicus below (Christian).

In the Right Mammillary Line, the level of the 5th chondro-sternal articulation (or a point 1 inch below the nipple [Gray]) above and a point ½ inch below the free margin of the costal cartilages below in the erect posture. In the recumbent posture the liver ascends 1 inch and is entirely covered by the ribs except at the subcostal angle (Treves).

In the Right Axillary Line the lower border of the 6th rib above and the lower border of the 11th rib (level of the 2d lumbar spine) below (Treves).

In the Right Scapular Line the upper border of the 10th rib or 10th dorsal vertebra above and the lower border of the 11th rib or 11th dorsal vertebra below (Treves).

In the Vertebral Lines the liver corresponds to the position and width of the 10th and 11th dorsal vertebrae. (Quain).

The lower edge, as it crosses the subcostal angle, is represented by a line drawn across from the 9th right to the 8th left costal cartilage (Treves).

THE GALL BLADDER.

The gall bladder lies in a depression on the under surface of the right lobe of the liver. It is obliquely situated, its fundus being directed downward, forward and to the right and projecting beyond the anterior border of the liver. The neck ends near the right end of the transverse fissure of the liver. Its shape is conical or pyriform, its size is 4x1 inches, and its capacity 8 to 10 drachms.

The fundus of the gall bladder is situated just behind the 9th right costal cartilage close to the outer border of the right rectus muscle (Treves).

THE STOMACH.

The stomach, when empty, lies at the back of the abdomen, beneath the liver and some distance from the anterior abdominal wall. When distended it is brought well against the anterior abdominal wall and may extend in the middle line downward as far as the umbilicus, or even to Poupart's ligament; the lower border is then elevated and brought forward, the anterior surface looking upward and the posterior looking downward (Treves). When moderately distended its shape is pyriform or conical and curved, its size is about 12x4 inches, its weight 4½ oz, and its capacity very variable.

The cardiac orifice is situated behind the 7th left costal cartilage about 1 inch from the sternum and is on a level with the 9th dorsal spine (Treves).

The pyloric orifice, when the stomach is empty, lies behind the liver on the right of the anterior median line 2 or 3 inches below the sterno-xiphoid articulation on a level with a line joining the bony ends of the 7th ribs (Treves) or near the 8th right costal cartilage (Gray). It is on a level behind with the 12th dorsal spine. When the stomach is distended the pylorus is moved 3 inches to the right (Treves).

The lower border, when the stomach is empty, corresponds with a horizontal line joining the extreme anterior tips of the 10th costal cartilages (Treves).

The fundus is on a level with the 6th left sterno-chondral articulation, being a little above and behind the heart apex (Treves).

THE SMALL INTESTINE.

The convolutions of the small intestine lie in all the regions of the abdomen. It is about 22½ feet long.

THE CAECUM.

The caecum is in the right iliac fossa, its apex corresponding to a point a little internal to the middle of Poupart's ligament. Its size is 3 inches wide and 2½ inches long (Treves).

THE APPENDIX VERMIFORMIS.

The appendix lies *generally* in the right inguinal region behind the ileum and points toward the spleen. It sometimes occupies other positions, such as behind the caecum and in the right or left inguinal canals (Treves).

It corresponds in position to about McBurney's point and is on an average 4 inches long.

THE ASCENDING AND DESCENDING COLONS.

These run up and down the right and left lumbar regions respectively in front of the two kidneys (Gray).

The ascending colon is 8 inches long and the descending colon 8½ inches long.

THE TRANSVERSE COLON.

This lies across the abdomen opposite the junction of the epigastric and umbilical regions. The lower border is on a level with the umbilicus (Gray and Treves). It is 20 inches long.

THE SIGMOID FLEXURE.

This lies in the left iliac fossa extending from the crest of the ilium to the sacro-iliac symphysis (Gray.) The "*omega loop*," formed by the sigmoid flexure and the first part of the rectum, is 17½ inches long.

THE SPLEEN.

The Spleen is obliquely situated in the abdomen, and lies opposite the 9th, 10th, and 11th ribs between the anterior and posterior axillary lines (Gray). Its shape is oblong and flat, its size is about 5x3½x1¼ inches and its weight about 7 oz.

Its upper limit corresponds to the upper border of the 9th rib.

Its lower limit corresponds to the lower border of the 11th rib.

Its outer surface corresponds to the 9th, 10th and 11th ribs.

Its inner surface is in contact with the cardiac or large end of the stomach.

Its anterior border almost corresponds with the anterior axillary line, being just to the left of it.

Its posterior border almost corresponds with the posterior axillary line, being just to the right of it.

The spleen is generally somewhat enlarged and may be so enlarged as to fill nearly the whole abdomen and occupy both iliac fossae.

THE PANCREAS.

The Pancreas lies across the median line behind the stomach, 2 or 3 inches above the umbilicus, and opposite the 1st and 2d lumbar vertebrae (Treves). Its shape is oblong and that of a dog's tongue, its size is about 7x1½x¾ inches and its weight about 3 oz., though it may reach 6 oz.

THE KIDNEYS.

The kidneys lie opposite the last two dorsal and first two lumbar spines. Their shape is "kidney-shaped," their size is 4x2x1 inches, the left being the larger, and their weight is 4½ oz. in the male (Gray).

The upper end of the left kidney is on a level with the upper border of the 11th rib.

The upper end of the right kidney is on a level with the lower border of the 11th rib.

The lower end of the left kidney is 1¼ inches above the crest of the ilium at its highest point (Christian).

The lower end of the right kidney is ¾ inch above the crest of the ilium at its highest point, and on a level with the umbilicus.

The right kidney is ½ inch lower than the left on account of the large right lobe of the liver above.

A vertical line drawn upwards from the middle of Poupart's ligament has ⅓ of the kidney on its outer side and ⅔ on its inner side (Treves).

THE PELVIS.

The parts of the pelvis for examination are :

The shape, the size, and the contents or organs.

REGIONAL ANATOMY OF THE PELVIC ORGANS.

THE BLADDER.

The bladder, when empty, lies in the pelvis behind the pubes and close to the anterior wall of the pelvis.

When distended, it rises out of the pelvis and sometimes reaches the umbilicus and even the diaphragm. As the distention increases, the bladder is brought more and more in contact with the anterior abdominal wall. Its usual capacity is 1 pint; but it may contain several quarts (Treves), and its shape when it is moderately distended is ovoid.

THE PROSTATE.

The prostate gland is situated in the pelvis at the neck of the bladder about ¾ inch below the symphysis pubis and from 1½ to 2 inches from the anus (Treves). Its size and shape are those of a horsechestnut, about 1½x1x¾ inches.

THE RECTUM.

The rectum is entirely in the pelvis, having in its front the bladder in the male and the uterus and vagina in the female, and behind it the sacrum. It is about 8 inches long.

THE UTERUS.

The uterus is situated near the middle of the pelvis, behind the bladder and in front of the rectum.

The *fundus* is just below the level of the brim of the pelvis and the *cervix* about 2 inches from the vulva. Its shape is that of a seckel pear, its size is 3x2x1 inches, and its weight about 1 oz. (Gray & Treves).

THE OVARIES.

The ovaries are situated in the pelvis on each side of the uterus and about 1 inch from the latter. Their shape is oval (almond) and their size is 1½x¾x⅓ inches or that of a pigeon's egg.

THE VAGINA.

The vagina is in the lower anterior portion of the pelvis, having the bladder in front and above and the

rectum behind and below. Its anterior wall is 2 inches long and the posterior wall 3 inches. The long axis is almost parallel with the pelvic brim antero-posteriorly.

THE UPPER AND LOWER EXTREMITIES.

The parts for examination are ;—

The skin, the shape, the size, the length, the position, the muscles, the bones, the joints, the blood vessels, the lymphatic glands of the groin the axillae, and the epitrochlear gland, &c.

EXAMINATION OF A PATIENT.

In examining a patient for the diagnosis of disease the examination should be made—

I. *By questioning*, and II. *By physical examination.*

Before the physical examination is begun the patient should be rigidly questioned by the medical examiner, and encouraged to give all manner of information, which may be thus classified :—

I. *The family history*, II. *The personal history*, and III. *The history of the present trouble*, i. e., its cause, symptoms, general course, &c.

The physical examination may then be commenced.

Physical Diagnosis.

The general method pursued in this work includes the study of

(1) *The normal healthy human subject*, and (2) *The diseased human subject.*

There are signs and symptoms of health as well as of disease, and no one can hope to be able to recognize intelligently the symptoms and signs of disease, until he is thoroughly acquainted with those of health.

The physical diagnosis of the normal, healthy, human subject then demands consideration before we pass on to the same subject in diseased conditions.

Too much emphasis cannot be laid upon the necessity for *thoroughness* in the examination of a patient; for no examination can be complete, no diagnosis infallible, until every part of the body and every organ in the body has been *thoroughly* examined, from the crown of the head to the soles of the feet. If this precaution is neglected the patient will suffer and his physician will be mortified by allowing his *consultant* to discover what he has overlooked.

The book from which every student should learn this important branch of medicine is *the living being;* and while text books furnish a valuable *guide* to its study, still a useful, practical, knowledge can only be obtained from the *living* source both in health and disease. And though at the first glance difficulties appear great and insurmountable, they soon vanish in the light of object lessons learned from practical demonstration. Under all circumstances the patient should be manipulated and treated with that gentleness, deference, and courtesy,

owed to all men by the followers of this, the noblest of professions.

The presentation of a few definitions seem to be called for, before we enter upon the subject of this work.

Life is that state of protoplasm, or of an animal or plant, in which it is capable of metabolism when placed under proper conditions. (N. M. D.)

Death is the cessation of life (N. M. D.)—or that state of protoplasm, or of an animal or plant, in which there is total and permanent cessation of all the vital functions, when the organs have not only ceased to act, but have lost the susceptibility of renewed action. (W. D.)

Health is that condition of the body and its organs necessary to the proper performance of their normal functions (Gould).

Disease is any disturbance of an organism causing an abnormal variation in function or anatomical structure (N. M. D).

Prognosis is knowledge or prediction of that which will occur in the course of a disease (N. M. D).

A Symptom is any phenomenon which in the living subject gives evidence of the existence of a diseased condition (Roberts.)

Varieties of Symptoms—These are :

Subjective,
Objective,
Pathognomonic,
Diagnostic,
Local,
General (Constitutional),
Premonitory (Precursory),
Prognostic,
Therapeutic.

A Subjective Symptom is one elicited by inquiry and observed by the patient—e. g., pain, tenderness, headache, vertigo, &c.

An Objective Symptom is one observed by the medcal examiner or physician—e. g., redness, swelling, râles, heart murmur, &c.

A Pathognomonic Symptom is one characteristic of a particular disease and distinguishes that disease from other similar diseases—e. g., "rusty sputum" of pneumonia, "strawberry tongue" of scarlet fever, "impulse on coughing" in hernia, &c.

A Diagnostic Symptom is one that simply suggests the presence of a certain disease or aids in its diagnosis, but does not positively distinguish it from other diseases as a pathognomonic symptom does.

The remaining varieties of symptoms are sufficiently defined by their names.

A Sign is a symptom that points to the nature of the disease;—in other words, it is a diagnostic or pathognomonic symptom; e. g., rusty sputum, bronchophony, impulse on coughing, râles, &c.

Physical Signs are those obtained by the special methods of examination, inspection, palpation, percussion, auscultation, succussion, mensuration, paracentesis, calormetation, &c., in which the examiner makes use of his special senses, sight, touch, hearing, &c. They are really objective symptoms:—e. g., redness, fluctuation, dullness on percussion, &c., bronchial respiration, râles, pyrexia, &c.

Diagnosis is the art of distinguishing health from disease and one disease from another by means of its symptoms.

Physical Diagnosis is the art of distinguishing health from disease and one disease from another by means of the physical signs presented in each case. It

approaches nearer to an exact science than any other branch of medicine, and it may truly be termed the "Mathematics of Medecine" (Page).

By this means it is possible to diagnose disease without the aid of the patient.

Methods of Physical Examination.

These are :—

(1) Mensuration.
(2) Succussion.
(3) Calormetation.
(4) Paracentesis.
(5) Examination of Excretions.
(6) Examination of the Blood.
(7) Inspection.
(8) Palpation.
(9) Percussion.
(10) Auscultation.
(11) Auscultatory-Percussion.

MENSURATION.

Mensuration is the act of measuring (a patient) in order to ascertain the presence or absence of any deviation from the normal condition, and also to compare one part or side with another.

It is performed by means of a tape line usually, though other more complicated instruments are sometimes employed, as the stethometer, spirometer, cyrtometer, &c.

It may be applied to any part of the body (the head, neck, chest, abdomen, extremities, &c.).

In mensuration of the chest the purpose is twofold, *i. e.*,

(1) to compare the two sides of the chest either during repose or during inspiration and expiration ; and

(2) to ascertain the total amount of expansibility of the chest.

In right-handed persons the right side of the chest is the larger, while in left-handed persons the reverse is the case.

In comparing the two sides of the body by mensuration, one end of the tape line is applied to the middle line behind and the line is then carried around one side to the median line in front. The two halves or sides of the body are thus measured and compared, care being taken that the measurements are made at the same level on the two sides. In measuring the total amount of expansibility of the chest the tape line is applied around the chest just above the nipples on a level with the 6th costo-sternal articulation. The patient is then made to empty the chest entirely and the measure is taken. He is then required to fill the lungs by a deep inspiration. This causes expansion and the measure is noted. The two measurements are then compared and the one substracted from the other. The difference in inches gives the amount of expansibility of the chest. The normal amount of expansion varies from 2 inches to 6 inches in adults. Three inches is good expansion.

A man 6 feet high should measure around the chest 41 inches.

A man 5 feet and 8 inches tall should measure 38½ inches (Page).

In comparing the length of the two lower extremities the measurements should be made from between the two central incisor teeth, or from the centre of the interclavicular notch, or from a point midway between the two anterior superior spinous processes of the ilia. In the case of the upper extremities the measurements should be made from the tip of the acromion process, or from the centre of the interclavicular notch (in the latter case the upper extremity should be at right angles to the body) (Christian).

The affections requiring the use of mensuration are fractures, dislocations, swellings, tumors, hypertrophies, hydrothorax, pyothorax, hydrops articuli, atrophies, &c.

SUCCUSSION.

Succussion is the act of shaking a patient in order to ascertain the presence or absence of fluid in any part of the body.

It is performed by grasping the patient firmly by the two shoulders, and shaking him from side to side, while the ear of the examiner is applied to the part to be examined. This gives rise to a *splashing sound* when fluid and air are both present in a cavity, as the pleural cavity or a large pulmonary cavity.

It is applied to any part of the body in which there is a large cavity containing both fluid and air (or gas); but the pleural cavity and large pulmonary cavities seem to have monopolized its use. Succussion was invented by Hypocrates 460 to 375 B. C.

The physical sign obtained by this method is the *splashing sound* described above.

The diseases in which it is employed are pneumo-hydro-thorax, pneumo-pyo-thorax, and pulmonary cavities containing fluid and air. Succussion is not much used now, as paracentesis has taken its place.

PARACENTESIS.

Paracentesis is the operation of piercing or tapping a cavity of the body for the evacuation of fluid.

It is performed by means of a hollow needle attached to a pump either directly or by means of a rubber tube with a vacuum between the needle and the pump. This apparatus is called an aspirator. The needle is passed into the cavity through its wall, and if fluid is present it may thus be pumped out.

It may be applied to any of the cavities of the body that contain too much fluid, as the ventricles of the brain, the antrum of Highmore, the thorax, the pericardium, the peritoneal cavity, the bladder, a joint, an abscess, the pelvis of the kidney, a cystic tumor, &c.

The physical sign obtained by this method is the *fluid spurting* through the needle, and the instruments usually employed are the hypodermic syringe and the aspirator.

The diseases to which paracentesis is applicable are: hydrocephalus, dropsy of the antrum, hydrothorax, pyothorax, hydropericardium, ascites, distended bladder, hydrops articuli, abscess, cystic tumor, &c.

The puncture with the aspirating needle should be made in the case of:—

Hydrocephalus, between the 3d and 4th lumbar vertebrae, as at this point the spinal cord cannot be touched, and the removal of fluid is slower with less danger of collapse. (Osler).

Dropsy of the Antrum; the antrum may be drained by the extraction of the 1st or 2d molar tooth and enlarging the opening; or by making an incision through the skin just above the 1st molar and trephining the bone.

Hydrothorax, at the junction of the axillary line with the 7th intercostal space; or at the lower angle of the scapula in the 8th intercostal space, the hand of the patient being first carried around to the other shoulder so as to widen the intercostal spaces. (Osler).

Hydropericardium, in the 4th left intercostal space either close to the sternum or 1 inch from it; or in the 5th left intercostal space 1½ inches from the sternum. (Osler).

Ascites, in the median line half way between the umbilicus and symphisis pubis, the bladder having been

previously emptied, and the patient being in the sitting posture. (Page).

Distended Bladder, in the median line just above the symphysis pubis.

Hydrops Articuli, Abscess and Cystic tumor, wherever fluctuation is most distinct.

CALORMETATION.

Calormetation is the act of measuring the temperature of a patient, in order to ascertain the presence or absence of pyrexia.

It is performed either by the application of the hand to the skin surface generally of the abdomen or chest beneath the clothes, or by the use of the clinical thermometer. The former method is very inaccurate.

When the thermometer is used it may be applied either in the mouth (under the tongue with the lips closed tightly), in the axilla (with the arm pressed firmly against the side), or in the rectum. The mouth should always be preferred in the case of adults, and the rectum in the case of children. There is a difference of from a half to one degree in the temperature of these three localities, that of the rectum being the highest and that of the axilla the lowest.

The physical sign obtained by this method is the degree of temperature.

The diseases requiring the use of calormetation are, the eruptive fevers, inflammatory diseases, septic conditions, &c.; in fine, all diseases.

EXAMINATION OF EXCRETIONS.

The excretions to be examined are, the sputum, the urine, the feces, &c., in order to ascertain the presence or absence of abnormal constituents such as blood, pus, bacteria, albumin, peptone, sugar, bile, too much acidity or alkalinity, casts, fats, phosphates, urates, uric acid, urea, oxalate of lime, &c.

It is performed chemically by means of various chemical reagents, and miscroscopically by the use of the microscope.

The diseases demanding the above examination are, pulmonary affections, renal affections, hepatic affections, intestinal affections, the various eruptive fevers, malaria, &c.

The urine, though, should be examined in the case of all diseases.

CHARACTERISTIC SPUTA.

Mucus Sputa occur in acute bronchitis.

Frothy Sputa occur in acute bronchitis.

Mucus Sputa streaked with blood occur in acute bronchitis.

Muco-pus Sputa occur in chronic bronchitis.

Pure Pus Sputa occur in abscess of the lung.

Brick-dust or Rusty Sputa occur in acute lobar pneumonia.

Serous Sputa occur in pulmonary oedema.

Pure Blood Sputa occur in pulmonary apoplexy.

Brownish-red Sputa occur in hemorrhagic infarction of the lung.

Current Jelly (Reddish-brown) Sputa (with cancer cells) occur in cancer of the lungs.

Prune Juice Sputa occur in gangrene of the lung.

Vesicles or Hooklets in the Sputa indicate hydatids of the lung or hydatids of the liver with rupture of the cyst into a bronchial tube.

CHARACTERISTIC URINE.

(Purdy).

Mucus in the urine occurs both in health and disease.

In health, it is in small amount.

In disease, it occurs in irritation and inflammation of the urinary passages (kidneys, ureters, bladder, urethra), in febrile affections, &c.

Pus in the urine occurs in irritation and inflammation of the urinary passages (kidneys, ureters, bladder, urethra), disease of the prostate, rupture of abscess into urinary passages, nephritis, pyelitis, cystitis, urethritis; calculus, tuberculosis, ulceration, gonorrhoea, cancer, wounds, &c., of urinary passages.

Blood in the urine occurs in hemorrhages in the urinary passages (kidneys, ureters, bladder, urethra), as in nephritis, pyelitis, cystitis, urethritis; calculus, ulceration, malignant growths, of urinary passages, tuberculosis of urinary passages, parasite in the kidney (bilharzia haematobi), cystic disease of the kidney; abscess, embolism, hydatids, all of the kidney; acute febrile affections, purpura hemorrhagica, uterine and crural phlebitis, ingestion of turpentine, contharides, and other drugs, traumatism, (as by penetrating wounds, blows, concussion,) &c.

Bile in the urine (bile acids, and pigments) (biliuria), gives a dark greenish brown color, and occurs both in health and disease.

In health, it is in small amount.

In disease, it occurs after active exertion, changes of temperature and atmospheric pressure, use of alcohol; in liver diseases, jaundice from any cause, malaria, febrile affections, leucocythaemia, anaemia, scurvy, phosphorus poisoning, &c. Decrease of bile acids in the urine occurs in chronic interstitial nephritis.

Albumen in the urine (Albuminuria) may be serum-albumin, serum-globulin, fibrin, or haemaglobin. Egg-albumin may occur in the urine in health after an egg diet. The most common form of albumin in the urine is

serum-albumin, and when we use the term albumin in this connection, it means this form of albumin.

It is a debated question whether albumin appears in urine in health or not. It sometimes occurs with seemingly healthy kidneys, but it may be due to causes aside from kidney troubles themselves.

Causes of Albuminuria;

(1) Diseases of the kidneys.
(2) Increased diffusibility of the albumin of the blood, as in anaemia, infectious fevers (with micro-organisms in the blood), strumous and enfeebled conditions, certain forms of poisoning, &c.
(3) Increased blood pressure, as in violent and prolonged exercise, exposure to cold, vaso-motor disturbances, &c.

Sugar in the urine (glycosuria) may be glucose, levulose, lactose, inosite, &c.; but the most common form is glucose or grape sugar. It occurs both in health and disease.

In health it is in such small amount that it cannot be detected by the ordinary methods.

In disease it occurs:

(1) Temporarily in cholera, scarlatina, gout, intermittent fever, cerebro-spinal meningitis, diseases of the brain (especially if involving the 4th ventricle), lungs, and liver; after the administration of certain poisons as curare, morphine, strychnine, chloral, alcohol, turpentine, mercury, amyl nitrite, benzol, acetone, phloridzin, carbonic oxide, methyldelphinin, hydrocyanic acid, sulphuric acid, salicylic acid, uranium nitrite, &c.
(2) Experimentally after irritation of the floor of the 4th ventricle, section of the spinal cord, irritation of the vagus nerve, section of the sciatic nerve, section of the sphlancnic nerves, destruction of

sympathetic zanglia, injury of the vermiform process of cerebellum, extirpation of the pancreas in dogs, &c.; in irritation of the liver, increased blood in the liver, compression of the aorta, &c.

(3) Persistently in diabetes mellitus.

Peptone in the urine (peptonuria) occurs in:

Phosphorus poisoning, suppurative processes, cancer of the viscera (especially of the liver and intestines), pneumonia, scarlatina, acute rheumatism, typhoid fever, typhus fever, small pox, mumps, erysipelas, tuberculosis, empyema, apoplexy, catarrhal jaundice.

Fat in the urine (lipuria) occurs in health and disease:

In health, after a fatty diet and in pregnant women.

In disease, in chronic nephritis, fatty degeneration of the kidneys, phosphorus poisoning, diabetes mellitus, heart disease, disease of the pancreas, fracture of bones, acute yellow atrophy of the liver, &c.

Melanin in the urine (melanuria) occurs in cases of pigmented tumors or melanotic cancer or sarcoma, intermittent fever, wasting diseases, &c.

Leucin and Tyrosin (leucinuria and tyrosinuria) occur both in health and disease:

In health, during normal tissue metamorphosis:

In disease, when metamorphic changes are rapid, as in suppuration, gangrene, acute yellow atrophy of the liver, phosphorus poisoning, leucocythaemia, typhoid fever and small pox.

Indican in the urine occurs both in health and disease.

In health, after an exclusive meat diet.

In disease, in Addison's disease, cholera, cancer of the liver, chronic tuberculosis, diseases of the nervous system, typhoid fever, dysentery, obstruction of the small intestines. It indicates albuminous putrefaction somewhere.

For other abnormal constituents of the urine see Purdy's Practical Urinalysis and Urinary Diagnosis.

CHARACTERISTIC STOOLS.

Watery Stools are due to saline purgatives, serous diarrhoea, cholera, &c.

Mucus Stools indicate irritation or inflammation of the bowel.

Pus Stools, when pus is in small amount, indicate chronic inflammation or ulcer of the bowel : when in large amount they indicate the rupture of an abscess into the intestines.

Yellow or Green Stools (Bile Stools) indicate an excess of bile in the alimentary canal.

Bile in the stools stains them yellow or green or yellowish green ; when it is scanty or absent the stools are clay-colored or white.

The normal brown color of feces is due to the presence of urobilin, which is the changed bilirubin from the bile.

Bile pigment is not found in normal healthy stools.

Odorous Stools. The odor is very offensive in typhoid stools, vitiation of intestinal contents, smallpox, cholera, rheumatism, gout.

Stools are acid in rheumatism, gout, and intestinal catarrh.

Normal stools are alkaline.

Bloody Mucus Stools occur in dysentery.

Clay-colored Stools occur in simple atrophy of the liver, acute yellow atrophy of the liver, gastro-duodenal catarrh, torpid liver, echinococcus (hydatids) of the liver.

The clay-color is due to the absence of bile and the presence of undigested fat.

Fatty Stools occur in simple atrophy of the liver, acute yellow atrophy of the liver, gastro-duodenal catarrh, pancreatitis, cancer of the pancreas, &c.

The presence of undigested fat gives a light clay color to the stools.

Black Stools occur during the administration of certain drugs as iron, bismuth, &c.

Pure Blood Stools occur in simple ulcer of the bowel, typhoid ulcer of the bowel, gun-shot or stab-wound of the bowel, diseases of the liver, &c.

Tarry Stools indicate hemorrhage in the stomach or upper bowel.

Gall Stones in the Stools occur in cholelithiasis.

Rice Water Stools occur in Asiatic cholera, the 2d stage. They consist chiefly of serum from the blood.

Pea Soup Stools occur in typhoid fever.

Vesicles or Hooklets in the Stools indicate hydatids of the liver with rupture of the cyst into the bowel.

Ribbon or Tape-like Stools (flattened) occur in stricture of the anus or rectum.

EXAMINATION OF THE BLOOD.

This is performed chiefly by the aid of the microscope (but also chemically), and the purpose of the examination is to ascertain the number and condition of the red and white corpuscles, the presence of bacteria, animal parasites (plasmodium malariæ &c.), &c.

Diseases: anaemia, leucocythaemia, malignant growths, suppurative processes, relapsing fever, malaria, &c.

INSPECTION.

Inspection is the act of looking at the patient in order to ascertain the shape, size, movements, condition, appearances, &c., of the different parts of the body.

It is performed by making the patient stand or lie perfectly straight and symmetrically so that the different parts and sides may be examined by the eye and compared.

It may be applied to any part or to the whole of the body.

The physical signs obtained by inspection and the parts of the body to be inspected are mentioned under the name of each region as follows:

By inspection of the HEAD we ascertain:

(1) Its shape, size (hydrocephalus, rickets, idiots, &c.), Carriage (torticollis, Pott's disease), &c.;

(2) The presence of:
Tumors (sebaceous, osseous, &c.);
Pulsation (fontanelles, aneurism, &c.);

(3) The condition of the:
Hair (color, thickness, alopecia, dryness, length, &c.);
Scalp (sores, &c.);
Fontanelles (whether open or closed; the anterior fontanelle should close between the 15th and 20th month);
Parietal eminences (their size, rickets, &c.);
Face (skin, expression, dryness, rash, &c.);
Eye and its appendages [brows (falling out), lids, lashes, conjunctivae, cornea, sclera, pupils, iris, anterior chamber, foreign bodies, inflammation, ulcers, opacities, meibomian glands, &c.];
Ear (discharges, wax, deafness, foreign bodies, inflammation, &c.);
Temporal arteries (tortuosity, &c.);
Mouth and appendages:
Lips (blueness);
Teeth [crescentic, conical, early dentition (in syphilis and tuberculosis), late dentition (in rickets); lower central incisors appear first about the 7th month; a child 1 year old should have 8 teeth, and dentition should be finished between the 25th and 30th month: sordes on the teeth (in typhoid states)];

Tongue [shape, size, color ("strawberry tongue" of scarlet fever), papillae (enlarged, worms), tremulous (typhoid and depressed states), coating [yellow (liver diseases), white (stomach and bowel troubles), brown, black, cracked (typhoid states)];

Throat [coating (diphtheria, scarlet fever, ulcers, syphilis), granulations (chronic pharyngitis, &c.)] ;

Tonsils (size, coating, &c.).

By inspection of the NECK we ascertain :

(1) Its shape, size, &c.:

(2) The presence of :

Tumors ;

Pulsation [aneurism, jugular pulsation (heart disease), carotid pulsation (apoplexy)] ;

(3) The condition of the :

Skin (color, rash, dryness, &c.) ;

Lymphatic glands (enlarged) ;

Blood vessels, &c.

By inspection of the CHEST we ascertain :

(1) Its shape, size, &c :

(2) The presence of :

Tumors, (aneurism, sarcoma, fatty, &c.);

Pulsation (apex beat, enlargement of the heart, aneurism, vascular tumor, tumor near an artery).

(3) The condition of the :

Skin (color, rash, dryness, &c,);

(4) It symmetry and its respiratory movements, &c.

Symmetry of the chest :

The normal chest is symmetrical on the two sides to a great extent in form, size, and movements, though a perfectly symmetrical chest is rare (Page).

Variations from the normal symmetry of the chest:

(1) One side may be larger than normal, with or without bulging of the intercostal spaces.

Causes:

(a) *Occupation* (without bulging of intercostal spaces), as in persons who use one hand more than the other—e. g., carpenters and smiths. The enlargement is due to greater muscular development. This is compatible with healthy lungs.

(b) *Disease* (with bulging of intercostal spaces), as in hydrothorax, pyothorax, pneumothorax, pneumohydrothorax, haemothorax, hydropericardium, thoracic tumors, enlargement of the heart, &c., occurring on one side.

(2) One side may be smaller than normal with flattening of the chest walls and intercostal spaces.

Cause: Collapse and shrinkage of the lung, in which case atmospheric pressure forces in the chest wall in order to fill the vacuum that the lungs previously filled; e. g., interlobular pneumonia (fibroid phthisis); in this case contraction of the cicatricial tissue causes the shrinkage.

(3) Both sides may be larger than normal, with bulging of the chest walls and intercostal spaces.

Causes:

(a) *Over-distention* of air vesicles or pulmonary interstitial tissue on both sides, with air ("barrel-shaped chest"); e. g., pulmonary emphysema (vesicular and interstitial).

(b) *Over-distention* of both pleural cavities with fluid or air (this is rare); e. g., hydrothorax, pyothorax, pneumothorax, pneumohydrothorax, haemothorax, &c.

(4) One shoulder may be lower than normal:

Causes:

(a) *Occupation*, as in persons who use one shoulder more than the other; e. g., hod-carriers,

tailors, &c. This is compatible with healthy lungs.

(b) *Accident* or *Disease*, as in previous fracture of the clavicle (which generally results in the lowering of one shoulder), and in lateral curvature of the spine (the lower shoulder being on the side of the concavity). Both of these conditions are compatible with healthy lungs.

(5) Curvature of the spine, either anteroposterior or lateral. The scapula on the side of the convexity in lateral curvature is more prominent at its inferior angle than the other.

Normal respiratory movements of the chest.

These are expansion + contraction = inspiration + expiration = respiration. Every act of respiration is made up of inspiration or expansion and expiration or contraction of the chest, and these movements are visible over the whole thorax in health, and about equal on the two sides.

Inspiration is longer and more forcible than expiration and is active, while expiration is passive.

In men and infants the respiratory movememts are more distinct over the lower portion of the chest and over the abdomen, causing "abdominal respiration."

In women they are more distinct over the upper portion of the chest, "making superior costal respiration."

Frequency of respiration at different ages :

The respiratory movements are—

In infants, from 2 months to 2 years old, about 35 per minute ;

In children, from 2 years to 6 years old, about 23 per minute ;

In adults, about 16 to 20 per minute.

Abnormal respiratory movements of the Chest. These are :

(1) Increased Respiration (in frequency). This occurs in pulmonary affections, febrile affections, abdominal affections, and nervous affections; e. g., pneumonia, bronchitis, croup, asthma, &c.; typhoid fever, scarlatina, diphtheria, &c.; peritonitis, ascites, abdominal tumors, &c.; hysteria, &c.

(2) Slow, Labored, Irregular, Respiration, or Absent altogether, respiration being abdominal. This occurs in cerebral affections and indicates that there is pressure upon the brain somewhere; e. g., cerebral abscess, cerebral tumor. cerebral apoplexy, &c.

(3) Distinct Respiration on one side and Diminished on the other. This occurs when one lung is doing extra work owing to crippling of the other lung or other chest wall; e. g., single pneumonia, one-sided pleurisy, pleurodynia of one side; broken rib, intercostal neuralgia, fluid in *moderate* amount (hydrothorax, pyothorax, pneumothorax, haemothorax, pneumohydrothorax), on one side.

(4) Distinct Respiration on one side and Absent on the other. This occurs also when one lung is doing extra work owing to more complete crippling of the other lung by fluid in large amount in the pleural cavity; e.g., excessive, hydrothorax, pyothorax, haemothorax, pneumohydrothorax, &c.

(5) Depression during inspiration of suprasternal, supraclavicular and epigastric regions and intercostal spaces. This occurs when there is some obstruction to the entrance of air into the lungs, the depression being due to atmospheric pressure; e. g., croup, spasm of the glottis, pneumonia, bronchitis, asthma, foreign body, tumor, &c.

(6) Unequal Movements of the Scapulae. This occurs in chorea, hysteria, nervousness, alcoholism, tobaccoism, impostors, &c. The scapulae should move evenly up and down.

By inspection of the ABDOMEN we ascertain:—

(1) Its shape, size, movements, &c.;

(2) The presence of :

Tumors ;

Pulsation (epigastric pulsation, aneurism, &c.).

(3) The condition of the :

Skin (color, dryness, rash, &c.);

Umbilicus (hernia, &c.).

By inspection of the PELVIS we learn :—

(1) Its shape, size (only approximately), &c.;

(2) The condition of the :

Mons veneris [labia majora and minora (swelling, inflammation, hypertrophy, &c.)] ;

Clitoris (hypertrophy, &c.);

Hymen (rupture, &c.);

Fourchette (rupture, &c.);

Perineum (laceration, &c.) ;

Anus (piles, fistula, &c.) ;

Vagina (inflammation, discharges, ulcer, &c.) ;

Os uteri (laceration, polypi, &c.) ;

Cervix uteri (size, shape, &c).

The method of intra-pelvic inspection is by the use of the vaginal speculum and uterine sound.

By inspection of the EXTREMITIES we learn :

(1) Their shape, size, length, position, &c. ;

(2) The presence of ;

Tumors ;

Pulsation (aneurism, &c.) :

(3) The condition of the :

Skin, (color, dryness, rash, &c.) ;

Joints (shape, size, &c.) :

Lymphatic glands (axillary, inguinal, &c., enlargement, &c.)

PALPATION.

Palpation is the act of feeling the patient in order to ascertain the shape, size, movements, condition, and consistence of the different parts and organs of the body.

It is performed by the application of the palms of the hands, or better the palmar surfaces of the fingers, lightly, evenly, and firmly, to the parts to be examined, one or both hands being used.

It may be applied to the examination of the whole body.

The physical signs obtained by palpation and the parts of the body to be palpated are mentioned under the name of each region as follows :

By palpation of the HEAD we ascertain :—

(1) Its shape, size, &c.:

(2) The presence of ;

Pulsation (fontanelles, aneurism, &c.) :
Spots of tenderness (neuralgia, &c.) ;
Tumors and prominences (consistence) :
Fluctuation (abscess, hydrocephalus, cystic tumor, &c.) [See p. 50].

(3) The condition of the;

Fontanelles (whether open or closed ;—the anterior fontanelle should close between the 15th and 20th month.
Scalp ;
Hair (dryness, &c.) ;
Eyeballs [tension (glaucoma)] ;
Nose (coldness) ;
Ear (coldness) ;
Temporal arteries (hardness) ;

Face (coldness);
Tonsils (hardness, fluctuation);
Posterior auricular glands (enlargement).

By palpation of the NECK we learn:

(1) Its shape, size, &c.:
(2) The presence of;
Pulsation [jugular (heart disease), carotid (apoplexy), aneurism, &c.]:
Spots of tenderness (neuralgia, &c.):
Tumors, &c., (consistence, &c., fatty, adenoma, cystic, &c.):
Fluctuation (abscess, cystic tumor, &c.) (see p. 50):
(3) The condition of the;
Skin (dryness),
Posterior cervical glands (enlargement).

By palpation of the CHEST we ascertain:

(1) Its shape, size, and movements (vaguely);
(2) The amount of expansion and contraction (vaguely);
(3) The presence of;
A broken rib;
Spots of tenderness (pleurisy, intercostal neuralgia, broken rib, &c.,);
Pulsation (apex beat, aneurism, tumor near artery, &c.);
Tumors (consistence) &c.;
Fluctuation (see p. 50);
Fremitus (see p. 50);
(4) The surface temperature (very unreliable);
(5) The frequency and character of the pulse (which is obtained by feeling the radial artery at the wrist while the pulsations are counted by the watch);
(6) The frequency of respiration (which is obtained

by placing one hand upon the abdomen in men and infants and upon the upper part of the chest in women while the watch is held in the other hand, and the count is made);

(7) The condition of the;—
Skin (dryness, temperature, &c.);
Chest walls (ribs, &c.);

NOTE.

Fluctuation.

Fluctuation is the "wave-like" sensation obtained by pressure on or percussion of an enclosed mass of fluid.

It is obtained over an enclosed mass of fluid by placing the tip of one or more fingers of one hand on one side of the mass and by pressing or percussing lightly on the other side of the mass with the tips of the fingers of the other hand.

The wave-like sensation is caused by the presence of fluid in an enclosed cavity. Fluid, under these conditions, when displaced from one side, presses upon the other. E. g., abscess, cystic tumor, distended bladder, ascites, hydrops articuli, hydrothorax, pyothorax, hydropericardium, &c.

Fremitus.

Fremitus is the vibration or ~~joining~~ jarring of the chest walls caused by speaking, coughing, râles, friction of roughened pleural surfaces, or splashing of fluid in a cavity with air.

Varieties of Fremitus: These are Vocal, Tussive, Rhonchal, (Bronchial), Friction (Pleural), Splashing, according as it is produced by the voice, cough, râles, friction of pleural surfaces, or the splashing of fluid.

It is obtained all over the chest, by the application of

the palmar surfaces of the hands or fingers lightly, evenly, and firmly, to corresponding parts of the chest (one or both hands being used) while the patient slowly counts "one," "two," "three," and repeat;—but

It is modified both in health and disease in some regions by overlying structures, such as bone, muscle, fat, &c,, (the scapulae, pectoral muscles, &c.,) which weaken and diminish the fremitus.

It is typical in the left subclavicular region in health, as the fremitus obtained in this region is taken as the type with which that of the rest of the normal chest, and also of abnormal conditions, is compared.

Solids are better conductors of vibrations and hence of sound waves than either fluids or gases.

The air that enters the air passages is thrown into vibrations in the larynx, during the act of speaking, by the vocal cords, and these vibrations or sound waves are carried down through the trachea, bronchi, and air vesicles to the chest walls, which are likewise thrown into vibrations. These, as they pass downward, become smaller by being divided up among the increasing numbers of small tubes, and are finally still further broken up, diffused, and scattered in the innumerable air vesicles ; the chest walls are then jarred slightly and normally, and we call it *normal fremitus*.

If the air vesicles are filled up and solidified by inflammatory exudate or tubercle, the vibrations are not broken up, diffused, and scattered, but are conducted in toto by the solid lung tissue directly from the bronchial tubes to the chest walls, which are then jarred or thrilled more distinctly by these comparatively larger vibrations, and we call it *increased fremitus*.

If, however, the air vesicles are over distended and contain more air than normal, the vibrations are still more diffused and scattered or lost in the comparatively

greater amount of air (just as the little waves, caused by dropping a stone into the centre of a large pond of water, will be diffused and scattered or lost before they reach the banks), and we call it *diminished fremitus*.

If, on the other hand, the tubes and vesicles are normal, but something intervenes between the lung and chest wall, such as a very thick pleura or fluid or air in large amount in the chest cavity, so as to intercept the vibrations before they reach the walls of the chest, there will be no jarring or fremitus, and we say that fremitus is *absent*.

Exception. If the pleura is only slightly thickened, or if there is only a small amount of fluid or air in the chest cavity, there will be *diminished fremitus*.

The Amount of Fremitus in health depends on—

(1) The character of the voice; e. g., a loud, low-pitched, harsh, voice, other things being equal, causes more vocal fremitus than a high-pitched, soft, voice.

In men fremitus is greater in amount than in women.

In children fremitus is less in amount than in adults.

In the aged fremitus is less than in the young.

(2) The condition of the chest walls. Thin chest walls give more fremitus than thick, being more easily jarred.

VARIATIONS FROM NORMAL FREMITUS.

These are Increased Fremitus, Diminished Fremitus, and Absent Fremitus.

Increased Fremitus occurs both in health and disease:—

In health, it occurs all over the right side of the chest (that is, more is observed on the right side than in corresponding regions on the left), but especially in the

right subclavicular region, because the right primitive bronchus being larger than the left a larger volume of air or voice sound, and hence larger vibrations, are conveyed into the right lung than into the left.

In disease, it occurs when there is partial or complete solidification of lung tissue. In this case the vibrations are conducted by the solid lung tissue directly from the bronchial tubes to the chest walls and are not broken up, diffused and scattered in the air cells : e. g.,

Lobar Pneumonia, 2d and 3d stages ;

Pulmonary Tuberculosis, 2d and 3d stages.

Diminished Fremitus occurs both in health and disease.

In health it is due to overlying structures such as bone and muscles (scapulae, pectoral muscles, &c.) which interfere with or modify the normal vibrations.

In disease it is due to ;—

(1) Some Obstruction to the entrance of air into the lungs ; e. g., pressure by a tumor, stricture of a bronchial tube, spasm of a bronchial tube (asthma), mucus in a tube, swelling or thickening of a mucous membrane, (bronchitis), false membrane (croup).

or

(2) Great capacity of lung tissue to break up, diffuse, and scatter, the vibrations or sound waves before they reach the chest walls ;—e. g., distention of air vesicles or interstitial tissue with air (emphysema).

Absent Fremitus occurs when there is ;—

Some obstacle between the lung and chest wall that intercepts the vibrations ; e. g., very thick pleura, fluid or air in large amount in the chest cavity (hydrothorax, pyothorax, pneumothorax, pneumohydrothorax, pneumopyothorax, haemothorax).

Exception. If the pleura is only slightly thickened

or if there is only a small amount of fluid or air in the pleural cavity, there will only be *diminished fremitus*.

By palpation of the ABDOMEN we ascertain :

(1) Its shape, size (approximately), &c.;

(2) The presence of—

Pulsation (aneurism, epigastric pulsation due to enlargement of the heart, &c.);

Tumors (consistence, &c.);

Spots of tenderness (appendicitis, &c., McBurney's point, neuralgia, &c.);

Fluctuation (ascites, cystic tumor, distended bladder, abscess);

(3) The condition of the :

Skin (dryness, temperature);

Stomach (tumors, hardness, tenderness);

Small intestine (tumors, fecal impaction, tenderness);

Colon (tumors, fecal impaction, tenderness);

Caecum (tumors, fecal impaction, tenderness);

Appendix (tenderness, pitting of the skin, &c.);

Sigmoid flexure (tumors, fecal impaction, tenderness);

Liver (enlargement, tumors, tenderness);

Gall bladder (enlargement, distention with gall stones, tumors);

Pancreas (tumors, enlargement);

Kidneys (enlargement, tumors, floating, tenderness);

Spleen (enlargement, tumors, tenderness);

McBurney's Point. [In order to find the latter, draw a line from the anterior superior spine of the right ilium to the umbilicus. McBurney's Point is about 3 or 3½ inches from the former on this line, and is of interest in appendicitis, as it is opposite the most frequent position of the appendix.]

The Stomach, when normal, cannot be felt; but in case of tumor of this organ it may be perceptible by palpation on the left side of the epigastric region.

The pylorus, when hardened or enlarged, may be felt in the epigastric region just to the right of the median line from 2 to 3 inches below the sterno-xiphoid articulation on the level of a line drawn between the bony ends of the 7th ribs (Treves and Gray).

The Liver, even when normal, can be felt [its anterior sharp edge] by the educated hand ½ inch below the free margin of the costal cartilages and also at a point ¼ way between the ensiform cartilage and the umbilicus.

In enlargements of the liver [fatty, albuminoid, cancerous, &c.] and in "hobnailed liver," it can more easily be felt in the same places [Gray].

The Spleen, when normal, cannot be felt, so completely is it sheltered by the ribs; but when it is enlarged its lower border can be felt below the 10th and 11th ribs, especially when forced down by a deep inspiration [Gray].

The Pancreas, even when normal, can sometimes be felt lying across the median line 3 inches above the umbilicus, by deep pressure in emaciated subjects when the stomach and colon are empty (Treves).

The Gall Bladder, when normal, cannot be felt (as it is behind the 9th costal cartilage); but if it is distended by gall stones or fluid or the seat of tumor, it may possibly be detected by palpation just below the 9th right costal cartilage at the outer border of the right rectus muscle.

The Kidneys, when normal, cannot be felt. They are, however, most accessible to pressure (and if enlarged or floating can be felt) just beneath the last rib at the outer edge of the erector spinae muscle. If they

are tender we can ascertain the degree of tenderness at this point.

The Bladder, when normal, cannot be felt either when empty or normally full. When distended, however, it rises above the pubes towards the umbilicus and may reach the level of the latter or even touch the diaphragm. The outline of it is then perceptible to palpation.

Fluctuation may be detected when the bladder is distended by putting one finger into the rectum against the "trigone vesicae" and making pressure on the abdomen with the other hand (Gray).

The Intestines, both large and small, when normal, cannot be felt. When they are impacted with feces or the seat of tumor, the impaction or the tumor may possibly be detected by palpation.

The Colon, when normal, cannot be felt, but is accessible to pressure throughout its course, except at the hepatic and splenic flexures (Gray). When it is impacted with feces or the seat of tumor, the impaction and tumor can be detected often by palpation.

By palpation of the PELVIS we ascertain :

(1) Its shape, size, (approximately) &c.;

(2) The presence of,

Pulsation, (aneurism) &c.;
Tumors (consistence), &c.
Spots of tenderness, &c.

(3) The condition of the,

Mons veneris (tenderness, enlargement, &c.);
Labia majora and minora, (tenderness, enlargement, &c.,);
Clitoris (hypertropy, sensitiveness, &c.);
Urethra (caruncle, &c.);
Vulva (caruncle, &c.);
Hymen (rupture);

Perineum (lacerations, &c.);
Anus (piles, fistula, fissure, &c.);
Vagina (heat, induration, ulcer, &c.);
Os uteri (laceration, polypi, softness, tenderness, position, &c.);
Cervix uteri (shape, size, tenderness, &c.);
Corpus uteri (enlargement, tenderness, position, &c.);
Ovaries and fallopian tubes (shape, size, position, tenderness, mobility, adhesions, tumors, &c.)

By palpation of the EXTREMITIES we ascertain:

(1) Their shape, size, (approximately) &c.;

(2) The presence of,
Tumors, (consistence, &c.);
Preternatural mobility or immobility (fractures and dislocations);
Spots of tenderness (neuralgia, neuritis, rheumatism, fracture, crepitus, &c.),
Pulsation (aneurism, &c.);
Floating patella (hydrops articuli);
Continuity of bone, &c.;

(3) The condition of the,
Skin [dryness, temperature (unreliable)];
Lymphatic glands (axillary, epitrochlear, inguinal, syphilis, tuberculosis, &c.);
Joints (shape, size, grating, fluctuation, tenderness, &c).

Methods of Intrapelvic Palpation.

(1) Vaginal Palpation (with one or more fingers in the vagina).

(2) Abdominal Palpation (with one or more hands on the outside of the abdomen).

(3) Bimanual Palpation (with one or more fingers of

one hand in the vagina and the other hand on the abdomen).

(4) With instruments in the vagina and uterus (vaginal speculum, uterine sound, &c).

PERCUSSION.

(Page).

When a body is struck a certain sound is made which varies with the nature, condition, and consistence of that which is struck.

Percussion is the act of striking the patient in order to ascertain by the sound elicited the nature, condition and consistence of underlying parts, i. e., whether they are solid or contain fluid, gas, or air.

It is performed by striking the part of the body to be examined with a hammer of some sort (e. g., rubber) or with the tips of the first two fingers of the right hand, curved so as to bring the pulpy tips in contact with the part struck.

The blows may be delivered either directly (immediately) to the part, or indirectly (mediately) with something intervening between the hammer and the patient.

That which intervenes and receives the blow is called a plexímeter. This may consist of a flat, oblong, piece of ivory, hard rubber, &c., or it may be the middle finger of the left hand, the palmar surface being in contact with the skin.

The best hammer and plexímeter are the fingers, as above described. The plexímeter should be applied evenly and firmly, and the blow should be perpendicular, not too hard, short, sharp, and with *wrist* motion only (Page).

The sounds elicited by percussion over corresponding parts or levels on the two sides of the body should be compared, and several blows—from three to five—should be struck at each point examined (Page).

When the finger is used as the pleximeter in examining the chest, it should be pressed down evenly and firmly between and parallel with the ribs (Page).

It is generally sufficient to percuss gently and lightly; but forcible percussion is employed when the sound of deep seated organs is to be brought out.

Varieties of Percussion. These are:

(1) *Immediate* percussion, in which no pleximeter is used:

(2) *Mediate* percussion, in which a pleximeter is used: and

(3) *Palpatory* percussion, in which the fingers are used as the hammer and pleximeter, as above described.

It is applied chiefly to the chest and abdomen.

Physical sign obtained by percussion. This is,

The Percussion Sound, which is the sound obtained by percussion over any part of the body. It differs for different parts of the body according to the nature, condition, and consistence of the part—in other words according as the part percussed is solid or contains fluid, gas, or air.

It must be studied with reference to its duration, intensity, pitch, and quality. The latter is the most important.

Note. Intensity of sound in percussion signifies the amount of sound in the sense of "amplitude or volume"; while in auscultation it means amount of sound in the sense of "concentrated amount" (Page).

A large drum, containing a large amount of air, when struck, vibrates comparatively slowly and with ample vibrations, as there is plenty of room for vibrating. It therefore yields a sound of long duration, of great intensity (or volume), of low pitch, and of tympanitic (drum-like) quality.

A small drum, containing a small amount of air, when struck, vibrates quickly and with short vibrations, as there is not much room for vibrating. It therefore yields a sound of short duration, of small intensity, of high pitch, and of tympanitic quality.

A relaxed drum head, when struck, vibrates slowly and with ample vibrations, as there is plenty of "slack" for vibrating. It therefore yields a sound of long duration, of great intensity, of low pitch, and of tympanitic quality.

A tense drum-head, when struck, vibrates quickly and with short vibrations, as there is little or no "slack." It therefore yields a sound of short duration, of small intensity, of high pitch, and of tympanitic quality. Therefore,

A large drum with a relaxed drum-head, when struck, yields a sound of long duration, of great intensity, of low pitch, because there is plenty of room and "slack" for vibrating, and of tympanitic quality.

A small drum with a tense drum-head, when struck, yields a sound of short duration, of small intensity, of high pitch, as there is small room and little or no "slack" for vibrating, and of tympanitic quality.

Two drums of the same size and containing the same amount of air, the one having a relaxed drumhead and the other a tense one, would yield, when struck, a very different sound as to duration, intensity, and pitch; but the quality would remain tympanitic. Likewise:—

Two drums of different sizes and containing different amounts of air, but having drumheads of the same tension, would likewise yield, when struck, a very different sound as to duration, intensity, and pitch; but the quality would remain tympanitic.

Hence we have the following axioms:—

(1) The Duration of a sound may be long or short,

and it varies with the pitch—the longer the duration the lower the pitch, and vice versa.

(2) The Intensity of a sound may be great or small, and it varies with the duration and pitch—the greater the intensity, the longer the duration and the lower the pitch, and vice versa.

Note. Intensity of sound in percussion signifies amount of sound in the sense of "amplitude or volume: while in auscultation it signifies amount of sound in the sense of "concentrated amount."

(3) The Pitch of a sound may be high or low, and it varies with the duration and intensity—the higher the pitch the shorter the duration and the smaller the intensity, and vice versa.

(4) The Quality of a sound may be resonant (or clear), dull, flat, tympanitic (amphoric, metallic), cracked pot, (cracked mettle).

All the parts and organs of the body (muscles, bones, lungs, heart, liver, kidneys, spleen, stomach, bowels, &c.), even the most solid, contain *some* air, though in different amounts, and have different degrees of tension. They may, therefore, be compared to drums of different sizes and with different degrees of tension of the drumhead. When struck or percussed, these parts or organs yield, like the drums, sounds that differ according to the quantity of air (or gas) and degree of tension. As a rule, the greater the amount of air in an organ when struck or percussed, and the more relaxed an organ is, the more ample are the vibrations of its particles; and hence the longer is the duration, the greater the intensity, the lower the pitch, of the sound that it emits, and the nearer it approaches to *tympanicity*.

On the other hand, the smaller the amount of air in an organ when percussed, and the harder and more dense

and tense an organ is, the shorter will be the vibrations of its particles ; and hence the shorter is the duration, the smaller the intensity, the higher the pitch, of the sound that it emits, and the nearer it approaches to *flatness* (absence of air).

The Lungs contain considerable air and their tissues are considerably relaxed. They may be compared to a medium sized drum with a somewhat relaxed drumhead, whose vibrations would be medium. Therefore they yield, when percussed, a sound whose duration is relatively long, whose intensity is relatively great, whose pitch is relatively low, and whose quality is resonant (because it is resounding or clear), or vesicular (because it is the sound heard on percussion of normal air vesicles).

This sound, vesicular resonance, is the type with which all other percussion sounds must be compared.

The Solid Organs (the heart, liver, spleen, kidneys, lung when solidified, bones, muscles, &c.) contain very little air (though *some*) and their tissues are dense and tense. They may be compared to a small drum with a tense drumhead, whose vibrations would be short. Therefore they yield, when percussed, a sound whose duration is short, whose intensity is small, whose pitch is high, and whose quality is dull (i. e., it resounds very little or hardly at all).

A large Collection of Fluid enclosed in a cavity, as in hydrothorax, pyothorax, haemothorax, ascites, distended bladder, abscess, &c., contains practically no air. It may be compared to a drum filled with water, whose drumhead would not vibrate at all. Therefore it yields, when percussed, a sound whose duration is still shorter, whose intensity is still smaller, whose pitch is still higher, and whose quality is flat (i. e., it does not resound at all).

A large Collection of Air or gas enclosed in a cavity, as in pneumothorax, pulmonary cavity, distended stomach or bowels, may be compared to a large drum, the extent or amplitude of whose vibrations would depend on the tension of its drumhead. Therefore it yields, when percussed, a sound whose duration, intensity and pitch depend on the size of the cavity and the tension of its walls ; but the quality would be tympanitic.

VARIETIES OF PERCUSSION SOUND.

Resonance (Clearness), Dullness, Flatness, Tympanicity, Amphoricity, Cracked Pot Sound.

I Normal Vesicular (Pulmonary) Resonance (=Clearness). This is the percussion sound obtained over normal, healthy, air vesicles or lung tissue containing a moderate or considerable amount of air, which is normal.

The vibrations are medium in extent or comparatively ample, as the particles are not very close together on account of the moderate amount of air present between them giving room for vibration, and the sound is proportionately resonant or vesicular.

The percussion sound of the left subclavicular region in health is taken as the *type* with which that of all other parts of the body is compared.

By *analysis of a sound* in percussion is meant a consideration of its duration, intensity, pitch, and quality, compared with those of the type.

Analysis of normal vesicular resonance:—

Duration ; typical—somewhat long.
Intensity ; typical—somewhat great.
Pitch ; typical—somewhat low.
Quality ; resonant, vesicular, pulmonary.

It is obtained only in health, and all over the chest wherever there is normal lung tissue ; but

It is modified in some regions by overlying structures, such as bone, muscle, fat (scapula, pectoral muscles, &c.), which change the character of the sound somewhat, rendering it less resonant and causing it to verge upon dullness.

It is typical then in the left subclavicular region. In most of the other regions of the chest we obtain pretty fair vesicular resonance, but it is generally modified somewhat in all of them, and varies to some extent from the type.

A percussion sound may vary or differ from the type in two ways, thus :—If the amount of air in the organ percussed is diminished or is less than that in the typical organ the sound will be less resonant; and if the diminution be pushed still farther and continue till the air is absent the sound will become respectively dull and then flat.

On the other hand, if the amount of air is increased, there will be increased resonance on percussion ; and if the increase continues till the air is quite abundant the sound will become tympanitic (= drumlike).

Significance of nor. vesic. reso. It signifies the presence of a moderate or considerable amount of air in, and hence a normal, healthy, condition of, the air vesicles or lung tissue.

In Children normal vesicular resonance is more marked than in adults, because of thin chest walls.

In Women normal vesicular resonance is more marked then in men, because of thin chest walls and superior costal respiration.

In the Aged normal vesicular resonance is less marked than in the young, because the chest walls are more rigid and the lungs are smaller in volume.

II. DULLNESS. This is the percussion sound obtained over solid, almost airless, organs containing very little air, such as the heart, liver, spleen, kidneys, muscle, bone, solid tumors, solidified lung, &c. If the finger is used as a pleximeter a sense of resistance is perceptible.

The vibrations are short and quick compared with resonance, as the particles are close together on account of the very small amount of air between them, leaving very little room for vibrating, and the sound is proportionately less resonant or *dull.*

Analysis of dullness :

Duration: short, as the vibrations are short.

Intensity: small, as the volume is small on account of the short, quick, vibrations.

Pitch: high, on account of the high degree of tension of the body struck.

Quality: dull, on account of the small amount of air and lack of resonance.

It is obtained over solid organs as above stated, both in health and in disease.

In health, it occurs over the normally solid organs, as above stated, the heart, liver, spleen, kidneys, muscle, bone, &c., and

In disease, it occurs over enlargements of the above mentioned solid organs, over solid tumors, and over solidified lung tissue.

Overlying structures, such as the scapulae, sternum, pectoral muscles, cause the percussion note even over normal lung tissue to be duller than where they do not intervene.

Over the right subclavicular region, even in health, we obtain a percussion note that is less resonant and slightly duller than that on the left side.

Three reasons are given for this difference :—i. e.,

(1) Greater development of the right pectoral muscles in right handed persons. Should the patient be left handed the dullness would be on the left, but not always.

(2) The large right lobe of the liver acting as a solid foundation for the right lung to rest upon—the left lung resting upon the hollow stomach. The presence of the heart, however, on the left would seem to invalidate this reasoning.

(3) The thick walls of the right primitive bronchus, which is higher up and more superficial (nearer to the front) than the left. Flint, however, says the tnbe would give a tympanitic quality by its hollowness.

Significance of dullness: It signifies almost entire absence of air from and a solid condition of the organ percussed.

Diseases in which it occurs:—

Lobar pneumonia, 2d and 3d stages:
Pulmonary tuberculosis, 2d and 3d stages:
Thickened pleura, chronic pleurisy,
Solid tumors, and
Enlargement of the normally solid organs, in which case the area of dullness would be increased in the direction of the enlargement; e. g., in the case of;

The Heart, in hypertrophy, dilatation, fatty degeneration, &c.

The Liver, in amyloid and fatty degeneration, cancer, cirrhosis, hepatitis. cholelithiasis, gastro-duodenal catarrh, syphilis (gummata), hydatids, congestion, &c.;

The Spleen, in acute and chronic enlargements, as in fevers, leucocythaemia, amyloid degeneration, cancer, hydatids, syphilis (gummata), tuberculosis, &c.

The Kidneys, in amyloid degeneration, cancer, hydatids, tumors, &c.;
The Pancreas, in tumors, &c.;
The Uterus and Ovaries, in tumors, &c.

Whole Area of Cardiac Dullness.

As will be seen from the description of the outline of the heart, this area is more or less quadrilateral and corresponds to the latter, extending roughly speaking from the upper border of the 3d left costal cartilage to the upper border of the 6th left costal cartilage, and from a vertical line drawn just within the left nipple to a vertical line ½ inch to the right of the sternum.

Deep Area of Cardiac Dullness.

This corresponds to that part of the front of the heart that is covered by lung tissue, and is very irregular in shape. It is increased by enlargements of the heart and by inspiration and is diminished by expiration.

Superficial Area of Cardiac Dullness.

This is triangular and corresponds to that part of the front of the heart that is uncovered by lung tissue.

It is formed by the lower part of the right ventricle and by the apical portion of the left ventricle.

Its boundaries are as follows :

The Left Border extends from the middle of the sternum on a level with the upper border of the 4th costal crrtilages to the apex, curving outward.

The Lower Border extends from the apex horizontally to the right to the middle of the sterno-xiphoid articulation.

The Right Border extends from the middle of the sterno-xiphoid articulation up the middle of the sternum to the (starting point), i. e., level of the upper border of the 4th costal cartilages.

It is increased by enlargements of the heart, pericardial effusion and by expiration, and is diminished by emphysema and by a full inspiration.

III. FLATNESS. This is the percussion sound obtained over a large collection of fluid enclosed in a cavity with thin walls, as in hydrothorax, pyothorax, ascites, distended bladder, hydropericardium, abscess, hydrops articuli, &c. There is practically no air present.

The vibrations are still shorter and quicker than in dullness as the particles are still closer together, on account of the practically entire absence of air, leaving no room scarcely for vibrating, and the sound is proportionately duller, or *flat*.

Analysis of flatness :—

Duration : still shorter than in dullness, as the vibrations are shorter.

Intensity : still smaller than in dullness, as the volume is smaller on account of the shorter, quicker vibrations.

Pitch : still higher than in dullness, on account of the still higher degree of tension of the body struck.

Quality : flat, on account of the absence of air and total lack of resonance.

It is obtained only in disease and abnormal conditions, as above stated, over large collections of fluid enclosed in cavities with thin walls in any part of the body.

Significance of flatness : It signifies the almost entire absence of air or gas and the presence of fluid in large amount.

Diseases in which it occurs : Hydrothorax, pyothorax, haemothorax, pneumohydrothorax (over the fluid), hydropericardium, ascites, abscess, distended bladder, hydrops articuli, cystic tumor, &c.

IV. Tympanicity (=drum sound). This is the percussion sound obtained over a large closed cavity filled with air or gas and having tense, rather unyielding, walls and air in large amount, as in distended stomach and bowels, pulmonary cavity, &c.

The vibrations vary with the size of the cavity and the tension of its walls. In the case of a large cavity with relaxed and yielding walls the vibrations will be more ample than in the case of a small cavity with tense, unyielding, walls.

Analysis of tympanicity:

Duration, *Intensity*, *and Pitch* vary with the size of the cavity and the condition or tension of its walls.

Quality; tympanitic or drum like.

It is obtained over large collections of air or gas enclosed in tense, rather unyielding walls, in different parts of the body, both in health and in disease.

In health, it occurs over the upper part of the sternum (the trachea and primitive bronchi) and over the abdomen (the stomach and bowels).

In disease, it occurs over abnormal and large collections of air or gas in the chest and abdomen.

Significance of tympanicity. It signifies the presence of air or gas in large amount and enclosed in a cavity having tense, rather unyielding (somewhat yielding) walls.

Diseases in which it occurs: Pneumothorax, pneumohydrothorax (over the air), pneumopyothorax (over the air), pulmonary cavity, pulmonary emphysema, distended stomach or bowels.

V. Amphoricity (jug sound, metallic sound). This is a subvariety of tympanicity and is the percussion sound obtained over a superficial cavity filled with air in the upper part of the chest having hard, smooth, un-

yielding, walls and communicating freely with a bronchial tube.

It is best elicited with the mouth partly open.

The vibrations vary with the size of the cavity and the tension of its walls ; in the case of a large cavity the vibrations whould be more ample than in the case of a small cavity, &c.

This sound may be imitated by percussing the cheek made tense with the mouth partly open.

Analysis of Amphoricity:—

Duration, *Intensity*, and *Pitch*, vary with the size of the cavity and the tension and condition of its walls.

Quality: Amphoric, metallic.

It is obtained only in disease over a superficial pulmonary cavity situated in the upper part of the chest, as stated above and below, and does not occur in health.

Significance of Amphoricity. It signifies the presence of air or gas in large amount enclosed in a superficial cavity having hard, smooth, unyielding walls and communicating freely with a bronchial tube.

Disease in which it occurs : Pulmonary tuberculosis, 3d stage.

VI. Cracked Pot or Cracked Metal Sound. This is the percussion sound obtained by forcible percussion over a superficial cavity situated in the upper part of the chest, having tense but yielding walls, and communicating with a bronchial tube, the patient's mouth being open.

It is due in most cases to the sudden forcing of air out of a cavity through a somewhat small opening.

The sound may be imitated by clasping the hands together, so that the palms form a cavity, and striking them over the knee.

Significance. It signifies an accumulation of air at some point that communicates with the exterior ; but it

occurs in so many conditions that it is not of much value in diagnosis, and is only mentioned as a curiosity. Diseases in which it occurs :

Bronchitis of children ; Emphysema.

Pleurisy above the seat of effusion ; Pneumothorax.

Pericardial exudation ; Pulmonary Tuberculosis, 3d stage.

PERCUSSION SOUND

(in the different vertical lines of the chest).

Over the Sternum (anterior median and sternal lines):

Tympanicity or "Band-box Resonance," due to the trachea and primitive bronchi, occurs above the level of the upper border of the 3d costal cartilages. Dullness due to the heart and liver occurs from the level of the upper border of the 3d costal cartilages above to a point ¼ way between the ensiform cartilage and the umbilicus below. Then tympanicity returns below, due to the intestines large and small.

Note.—Heart dullness occurs between the upper border of the 3d costal cartilages and the lower end of the gladiolus, and liver dullness extends from the lower end of the gladiolus to a point ¼ way between the ensiform cartilage and the umbilicus.

The Mammillary Lines.

Right side.—Normal vesicular resonance occurs from above down to the upper border of the 6th rib ; then liver dullness down to a point ½ inch below the free border of the ribs, in the erect position ; then intestinal tympanicity.

Left side.—Normal vesicular resonance occurs from above down to the 4th rib: then heart dullness down to the 6th rib (and from a vertical line ½ inch to the right of the sternum to a vertical line just within the left nipple); then liver dullness or gastric tympanicity; then intestinal tympanicity.

Axillary Lines.

Right side.—Normal vesicular resonance occurs from above down to between 7th and 8th ribs (Da Costa says lower border of 6th rib); then liver dullness down to 11th rib; then intestinal tympanicity. (Page).

Left side.—Normal vesicular resonance occurs from above down to 9th rib; then spleen dullness, sometimes gastric tympanicity, down to 11th rib; then intestinal tympanicity. (Page).

Scapular Lines.

Right side.—Modified (by scapula) resonance occurs from above down to the lower border of 10th rib (Da Costa); then liver dullnes merging below into muscle dullness.

Left side.—Modified (by scapula) resonance down to lower border of 10th rib; then there may be intestinal tympanicity or spleen (when enlarged) dullness, merging below into muscle dullness. (Page.)

Vertebral Lines.

On both sides.—Modified (by muscles) resonance occurs from above down to the lower border of the 10th rib; then liver dullness merging below into muscle and kidney dullness (?).

AUSCULTATION.

All machines, even the most perfect, make some noise while working. The living human body is a most complicated machine and, however perfect in all its parts, is not by any means a noiseless one; and it is not altogether improbable that, were the sense of hearing acute enough, the working of every organ in the body could be heard.

As it is, we can only hear uniformly the working of the respiratory and the circulatory apparatuses.

Sometimes we hear sounds connected with the digestive apparatus, as in eructation, flatulence, borgorygmus,

&c., which are irregular and not uniform, and only indicate the presence of gas which is being moved by the peristaltic action of the stomach or bowels. This may occur in perfect health and only indicates disease when excessive in amount. In the latter case it generally means fermentation of food which has not been digested or some neurotic condition, and hence is characteristic of indigestion, both acute and chronic, neurasthenia, &c. The sounds made have no special significance. The regular sounds, that are heard in connection with the living human subject, and that will be discussed in this work, are those produced by the respiratory and circulatory systems, both in health and disease. These two systems when in a normal, healthy, condition produce sounds that are regular and uniform; but when diseased they produce other sounds that differ from the normal.

A close study of these sounds will enable the diagnostician to form a correct opinion of the condition of the organs that produce them.

The sounds made by the respiratory apparatus are:—

(1) Respiratory Sounds or Respiratory Murmur or Breath Sounds.
These are made by breathing and are both normal and abnormal.

(2) Vocal Resonance or Voice and Speech Sounds.
These are made by speaking and are both normal and abnormal.

(3) Adventitious Sounds (Râles, Friction Sounds, and Splashing Sounds).
These are made by the presence of impediments to the air in the air passages and by abnormal conditions of the pleural cavities and are always abnormal.

The Sounds made by the circulatory apparatus are:—

(1) Heart Sounds. These are made by the heart, and are both normal and abnormal. The latter may also be classed among adventitious sounds.

(2) Aneurismal Bruit. This is made by disease of some artery, and is always abnormal. It may, likewise, be placed among adventitious sounds.

The noisy organs of the body then are the respiratory organs and the circulatory organs, and the sounds made by then will be discussed in detail later on in this work.

AUSCULATION is the act of listening to a patient in order to ascertain the condition of the respiratory and circulatory systems by a study of the sounds made by those systems.

It is performed either directly by the application of the ear of the examiner to the body of the patient, or indirectly by the intervention of an instrument of some sort between the ear and the patient.

The instruments used are the stethoscope and the phonendoscope.

This gives rise to two varieties of Auscultation :—

(1) Immediate Auscultation, in which the ear of the examiner is applied directly to the patient; and

(2) Mediate Auscultation, in which an instrument intervenes between the examiner and the patient.

The latter method is employed chiefly in locating heart murmurs.

Hippocrates—460–375 B. C.—was the first to make use of auscultation ; but he only applied it to the detection of fluid in the pleural cavity in pneumohydrothorax by means of succussion.

It is applied principally to the chest, but may be employed anywhere for the detection of aneurism and transmitted heart murmurs.

Physical signs obtained by auscultation. These are :—

Respiratory Sounds ;
Vocal Resonance (Voice and Speech Sounds);
Adventitious Sounds (Râles, Friction Sounds, Splashing Sounds, &c.);
Heart Sounds ;
Aneurismal Bruit.

RESPIRATORY SOUNDS.

These are the sounds heard over the respiratory apparatus during the act of breathing.

They are obtained or heard over the whole respiratory apparatus by the application of the ear or stethoscope or phonendoscope to that part of the body.

They are caused by the friction of air against the walls of the larynx, trachea, and bronchial tubes, and by the expansion and contraction of the air vesicles, as air passes into and out of them.

When air enters the larynx of a healthy individual, the respiratory sound begins and the two (the air and the sound) are *conveyed* together through the trachea and bronchial tubes to the air vesicles. On reaching the bronchial tubes they (the air and the sound) begin to be divided up and distributed to the tubes as they divide and ramify, the divisions becoming smaller and smaller until they are diffused, refracted, and scattered in the air vesicles. They have a certain intensity that is normal and typical.

If the larynx, trachea, or bronchial tubes have their calibre diminished, as by spasm, stricture, tough mucus, swelling of mucous membrane, false membrane, pressure by a tumor, &c., the air current and the sound it makes are *obstructed* on their way and not as much of either reaches the lung tissue. The respiratory sound, as heard over the chest, is then *diminished* in intensity.

When the lung contains more air than normal, as when the air cells are over distended or there is air in the interstitial tissue of the lung, the tubes remaining the same, the air current and the sound are still more diffused, refracted, and scattered, just as the little waves made by dropping a pebble into the centre of a large pond of water are diffused and disappear before they reach the banks. The respiratory sound is then likewise *diminished* in intensity.

Exception.—In the case of a pulmonary cavity communicating with a bronchial tube, the intensity will be greater in the sense of volume, although there is more air in the lung. This is due to the cavity admitting a larger volume of sound.

Should the air vesicles be filled up and the lung tissue solidified by inflammatory exudate or tubercle—as in lobar pneumonia or pulmonary tuberculosis—the tubes remaining normal, the sound is caught up or received from the bronchial tubes by the solid lung before being diffused and scattered, and is *conducted* directly from the tubes by the solid lung to the chest walls. The respiratory sound is then *increased* in intensity.

Note. Solids conduct sound better than fluids or gases.

If, however, the tubes and vesicles are normal, but something intervenes between the lung and chest wall, as thickened pleura, fluid, or air in the chest cavity, so as to *intercept or interrupt* the sound before it reaches the walls of the chest, very little or no sound will be heard, and the respiratory sound is said to be *diminished* in intensity or *absent*, depending on the amount of fluid or air or thickening of the pleura.

Sometimes in chronic pleurisy strings or bands of adhesion form and extend between the lung and chest

wall, and the respiratory sound may be *transmitted* from the one to the other, even though there may be thickened pleura, fluid, or air, intervening, just as sound may be transmitted along a telephone wire.

We see then that these sounds are subjected to different conditions and contingencies in the normal and abnormal subject, thus,—

In the normal subject they arrive at the chest walls by—

(1) Convection or carrying along the tubes ; and by
(2) Refraction or diffusion in the air cells.

In the abnormal subject these sounds may be subjected to,

(1) Obstruction in the tubes by, spasm, stricture, tumor, tough mucus, swollen mucous membrane, false membrane ; e. g., asthma, stricture, croup, bronchitis, oedema glottidis, &c.
(2) Still greater refraction or diffusion in the air cells or lung, as when the air cells are over distended, or there is air in the interstitial tissue of the lung, the lung containing more air than normal ; e. g., emphysema (both vesicular and interstitial).
(3) Conduction, as when the lung tissue is solidified; e. g., lobar pneumonia, polmonary tuberculosis, &c.

Note. Solids conduct sounds better than fluids or gases.

(4) Interruption, as when there is thickened pleura, or fluid, or air, in the chest cavity ; e. g., chronic pleurisy, hydrothorax, pyothorax, haemothorax, pneumothorax, pneumohydrothorax, pneumopyothorax.
(5) Transmission, as when there are strings or bands of adhesion extending from the lung to the chest wall, transmitting the sound like a telephone wire ; e. g., chronic pleurisy.

Every act of respiration is made up of two factors, i. e., Inspiration and Expiration, which must be separated and each of which must be studied with regard to duration, intensity, pitch, and quality, and whether the two are continuous or not. Likewise each inspiration must be compared with the inspiration of normal vesicular respiration, and each expiration with its own inspiration.

This constitutes the *analysis* of respiratory sounds.

The respiratory sounds differ very much according as the larynx, trachea, bronchial tubes, or air vesicles, are examined, and also according as these organs are in a healthy or diseased condition.

This gives rise to the following varieties of Respiratory or Breath Sounds.

Varieties of Breath or Respiratory Sounds :

(1) Laryngeal Respiration ;
(2) Tracheal Respiration ;
(3) Bronchial Respiration ;
(4) Normal Vesicular (Pulmonary) Respiration ;
(5) Vesiculo-bronchial Respiration ;
(6) Cavernous Respiration ;
(7) Amphoric Respiration ;
(8) Emphysematous Respiration ;
(9) Vesiculo-cavernous Respiration ;
(10) Caverno-bronchial Respiration.

The study of laryngeal respiration and tracheal respiration is of so little importance that they will be dismissed without further mention than to say, that tracheal respiration resembles bronchial respiration except that it is more intense, as the trachea is larger than the bronchial tubes and there is a larger volume of air in it.

I. Normal Vesicular (Pulmonary) Respiration: This is the respiratory sound or murmur heard over normal, healthy, air vesicles.

It is a soft, breezy, rustling, somewhat low-pitched, sound, caused by the expansion and contraction of the air vesicles, and resembles the rustling of leaves on a tree. It is called *vesicular* because it is the sound made by the air vesicles.

Analysis of nor. vesic. resp.

Inspiration.

Duration: typical: somewhat long, but it varies in different individuals—four times as long as expiration and the two are continuous.

Intensity: typical: somewhat great, but it varies in different individuals—begins very small and increases towards the end.

Pitch: typical: somewhat low, but it varies in different individuals.

Quality: vesicular, breezy, rustling, resembling the rustling of leaves on a tree.

Expiration.

Duration: shorter than in inspiration, because in the latter the air current is directed towards the ear of the listener, while in expiration it is directed away from the listener.

Intensity: less than in inspiration.

Pitch: lower than in inspiration.

Quality: blowing.

The sound of expiration in health is absent in about one fourth of the cases examined.

In the analysis of respiratory sounds, each inspiration is compared with the inspiration of normal vesicular respiration, and each expiration is compared with its own inspiration. (See p. 78).

It is obtained or heard over the greater part of the chest, wherever there is normal, healthy, lung tissue; but

It is modified in some regions (in health) :

(1) By overlying structures, such as bone, muscle, fat, &c., (the scapulae, sternum, pectoral muscles, &c.), which render the sound less distinct or intense ;

(2) By other organs, such as the heart and liver, which encroach upon territory that should be occupied by lung tissue ; and

(3) By the condition of the chest walls, thin chest walls yielding more distinct and intense respiratory sound than thick.

It is typical in the left subclavicular region in health, as the sound heard in this region is taken as the type with which the breath sounds of other regions are compared. And while the sound of other regions is in health generally pretty fair vesicular breathing, still it is in some instances more or less modified by bone, muscle, fat, and other organs, which cause some difference from the type.

The sound heard in the two axillary and subscapular regions is almost typical, while that of the two supraclavicular, clavicular, mammary, submammary, subaxillary, suprascapular, and scapular regions, is somewhat obscured by overlying structures and other organs, and though not typical, yet it preserves its vesicular quality and is called vesicular.

Significance of nor. vesic. resp. : It signifies a normal, healthy, condition of the air vesicles or lung tissue.

Viriations in vesicular respiration.

Vesicular respiration may undergo changes which cause it to differ from the type, while still preserving in most instances its vesicular quality. Thus it may become :

(1) Wavy, Jerky, Cog-wheeled, Interrupted, either during inspiration, expiration, or both.

This is caused by the sudden overcoming of an obstruction in a bronchial tube, as in the case of

(a) Spasm of a tube ; e. g., spasmodic affections, hysteria, chorea, general nervousness;
(b) Pleurodynia ;
(c) Palpitation of the heart ;
(d) Stricture of a tube ;
(e) Mucus in a tube ; e. g., chronic bronchitis ;
(f) Alcoholism and tobaccoism ;
(g) A tubercular deposit, either in the wall of a tube or pressing upon a tube, or at the apex of the lung ; e. g., Incipient pulmonary tuberculosis.

(2) Prolonged in Expiration :
This denotes that the air has difficulty in getting out of the lung, and the causes are :—

(a) A loss of elasticity of the walls of the air cells, as when overdistended, infiltrated or solidified ;
e. g., Emphysema, causing overdistention ;
Pulmonary tuberculosis, causing infiltration of cell walls ;
Lobar pneumonia, causing solidification of air cells.

(b) Some obstruction in the tubes to the exit of air, as in spasm of the tubes, swelling of the mucous membrane, or pressure upon a tube, &c.;
e. g., Asthma, causing spasm ;
Bronchitis, causing swelling of the mucous membrane ;
Tumors, causing pressure, (aneurism. &c.)

(3) Rude, Harsh, Rough. This is caused by a roughening of the bronchial mucous membrane

by inflammation. The air in passing over the rough surface meets with more friction, and hence the rude, harsh, rough, sound; e. g., Chronic bronchitis.

Note. Some have applied these terms to vesiculo-bronchial respiration, making the two synonymous; but this is incorrect, as any kind of respiration may be rude, harsh, or rough, if the proper conditions exist for its production.

(4) Puerile. This is the kind of respiration that occurs normally in small children. It is less vesicular and more intense than in adults and has a bronchial element, because the air vesicles are not as fully developed in proportion to the bronchial tubes, which are fully developed.

Some have also applied this term to Increased, Exaggerated, Hypervesicular, Supplementary, Vicarious, Respiration; but this, too, is incorrect, as Puerile Respiration has more of a bronchial element, and the term should be limited to the breathing of children.

(5) Increased (in intensity), Exaggerated, Supplementary, Hypervesicular, Vicarious. This is caused by one lung or part of a lung doing extra work owing to crippling of the other. It occurs without any change in quality or rhythm;

e. g., single lobar pneumonia, single pleurisy; pleurodynia, broken rib, hydrothorax, pyothorax, haemothorax, pneumothorax, pneumohydrothorax, of one side, &c.

(6) Diminished (in intensity), Feeble. The causes are:—

(a) Some obstruction to the entrance of air into the lung, as in,

Affections of the larynx; e. g., croup, spasm, oedema, &c.;

Foreign bodies in the air passages;

Pressure by tumors; e. g., aneurism, &c.

Spasm of a bronchial tube; e. g., asthma.

Stricture of a bronchial tube or the trachea; e. g., after ulcer, wound, or old inflammation.

Thickened mucous membrane; e. g., bronchitis.

Mucus, pus, blood, &c., in the air passages, &c.; e. g., bronchitis, abscess, hemorrhage, &c.

(b) Greater capacity of lung tissue to break up, diffuse, and scatter, the sounds (= increased refractive power of the lungs) before they reach the chest walls. The causes of this are:

Overdistention of the air cells with air; e. g., vesicular emphysema.

Air in the pulmonary interstitial tissue; e. g., interstitial emphysema.

(c) Some mechanical interference with the expansion of the air cells. The causes of this are:—

Fluid in moderate amount in the pleural cavity; e. g., hydrothorax, pyothorax, haemothorax;

Tumors compressing the lung; e. g., aneurism, &c.;

Tubercular deposits in the pulmonary tissue causing loss of elasticity of the air cells; e. g., pulmonary tuberculosis.

(d) Deficient respiratory action. The causes of this are :
General debility ;
Impairment of nervous force ; e. g., paralysis ;
Local pain ; e. g., pleurisy, pleurodynia, intercostal neuralgia, broken rib, &c.

(7) Absent. The cause of this is :—
Some obstacle between the lung and chest wall that intercepts the sound ;
e. g., thickened pleura, as in chronic pleurisy ; fluid or air in large amount, as in hydrothorax, pyothorax, haemothorax, pneumothorax, pneumohydrothorax, pneumopyothorax.

In children, normal vesicular respiration becomes Puerile and is more intense than in adults, because of thin chest walls and the bronchial element.

In women, normal vesicular respiration is more marked than in men, because of thin chest walls.

In the aged, normal vesicular respiration is less intense than in the young, because the lung tissue has lost some of its elasticity, inspiration being shortened and expiration prolonged.

II. Bronchial Respiration. (Fig. 2).

This is the respiratory sound or murmur heard over normal, healthy, bronchial tubes.

It is a distinctly tubular, concentrated, high pitched sound, caused by the friction of air against the walls of the tubes, and resembles tracheal respiration (but is less intense) or the sound made by breathing through a tube. It may be imitated by blowing across the mouth of a stethoscope (Page).

It is the sound that is made in the bronchial tubes and that would be heard if the lung tissue could be removed and the tubes brought in contact with the chest walls.

It is more intense than normal vesicular respiration. Inspiration and expiration are *not* continuous, but there is a gap between them owing to inspiration being cut off or unfinished. Expiration is prolonged. The prolongation of expiration is due to the fact that solidified lung is a better conductor of sound and enables one to hear the murmur more distinctly and for a greater length of time.

Note. When a sound passes from a rare medium to a dense one the vibrations of the medium are shortened and the pitch of the sound is raised.

Analysis of bron. resp.

Inspiration :

Duration : shorter than in normal vesicular respiration, being unfinished.

Intensity : greater than in normal vesicular respiration in the sense of concentrated amount, as it is conducted with more force by the solidified lung.

Pitch : higher than in normal vesicular respiration, the sound having passed from a rare medium (the air in the bronchial tubes) to a dense one (the solid lung) with shorter vibrations.

Quality : tubular ; i. e., it sounds like air passing through a tube, as it does.

Expiration :

Duration : as long as or longer than in inspiration, owing to inspiration being unfinished and expiration being prolonged.

Intensity : greater than in inspiration.

Pitch : higher than in inspiration, owing to the natural conformation of the larynx.

Quality : more tubular than in inspiration (Page).

It is obtained or heard both in health and disease :

In health over the interscapular region, especially of the left side, as the left primitive bronchus comes

nearer the surface behind than the right. There are here few if any air vesicles to modify the sound.

In disease over solidified lung tissue. The sound of the air passing through the bronchial tubes is conducted directly to the chest walls by the solid lung tissue and is not diffused, refracted, and scattered, in the air cells (the latter being filled up and solidified). It is modified by :—

(1) Overlying structures ; e. g., bone, muscle, fat, &c.

(2) Thickened pleura ; e. g., chronic pleurisy.

(3) Fluid or air in the pleural cavity ; e. g., hydrothorax, pyothorax, haemothorax, pneumothorax, pneumohydrothorax, pneumopyothorax.

(4) Some obstruction to the entrance of air into the lungs, as stricture, spasm, mucus, swelling of mucous membrane, pressure by a tumor, &c.

e. g., Laryngeal affections, as croup, oedema glottidis, tumor, &c.;
Stricture of trachea or tubes ;
Asthma, causing spasm of a tube ;
Bronchitis, causing mucus or swelling of mucous membrane, &c.;
Tumor (aneurism) causing pressure, &c.

All of these may cause bronchial breathing to be less distinct or altogether suppressed, &c.

Significance of bron. resp.: It signifies complete solidification of lung tissue.

Diseases : It occurs in,
Lobar pneumonia, 2d and 3d stages ;
Pulmonary tuberculosis, 2d stage.

III. Vesiculo-bronchial Respiration. (Fig. 3).

This is the respiratory sound or murmur heard wherever there is a mixture of vesicular and bronchial elements.

It is more intense than normal vesicular respiration. Inspiration and expiration are *not* continuous; but there is a gap between them, as inspiration is unfinished. The gap, however, is not as wide as in bronchial respiration. Expiration is prolonged.

Analysis:

Inspiration:

Duration: shorter than in normal vesicular respiration, as it is barely finished (unfinished).

Intensity: slightly greater than in normal vesicular respiration, in the sense of concentrated amount, as it is conducted with more force by the partially solidified tissue.

Pitch: slightly higher than in normal vesicular respiration.

Quality: less vesicular than in normal vesicular respiration, as there are fewer vesicles taking part in the respiration.

Expiration:

Duration: as long as or longer than in inspiration.

Intensity: the same as in inspiration.

Pitch: as high as or higher than in inspiration.

Quality: somewhat tubular (more tubular than in inspiration).

It is obtained or heard both in health and disease:

In health, over the right subclavicular region, because the right primitive bronchus being larger and more superficial than the left, imparts to respiration in this region a bronchial element.

In disease, over partially solidified lung tissue, as the latter is a better conductor of sound than normal lung tissue, and conducts it from the tubes directly to the chest walls; but it has a vesicular element as some of the air vesicles are still open.

It may be modified :

(1) By overlying structures ; e. g., bone, muscle, fat, &c.

(2) By thickened pleura ; e. g., chronic pleurisy.

(3) By fluid or air in the pleural cavity ; e. g., hydrothorax, pyothorax, haemothorax, pneumothorax, pneumohydrothorax, pneumopyothorax.

(4) By some obstruction to the entrance of air, as spasm, stricture, mucus, swelling of mucous membrane, pressure, &c.,—e. g.,

Laryngeal affections, as croup, oedema glottidis, tumor, &c. ;

Stricture of trachea or tubes, &c. ;

Asthma, causing spasm ;

Bronchitis, causing mucus or swelling of mucous membrane, &c. ;

Tumor, causing pressure, &c., as aneurism.

All of these may cause the sound to be less distinct or altogether suppressed.

Vesiculo-bronchial respiration has been termed by some rude, harsh, rough, breathing ; but this is incorrect and not descriptive, as any respiration may be rude, harsh, rough, &c., provided the bronchial mucous membrane has been roughened by inflammation.

Significance of vesiculo-bron. resp.: It signifies partial solidification of lung tissue.

Disease. It occurs in pulmonary tuberculosis, 1st stage.

IV. Cavernous Respiration. (Fig. 4).

This is the respiratory sound or murmur heard over a pulmonary cavity communicating with a bronchial tube.

It gives the idea of air passing in and out of a hollow space or cavity, and is more intense than normal vesicular respiration in the sense of volume.

Inspiration and expiration are about equal in duration, though expiration is sometimes longer than inspiration, as the latter is sometimes deferred. This is owing to the fact that the air flows into the cavity a considerable time before the sound begins. The two are continuous.

It is modified :

(1) By overlying structures, as bone, muscles, &c. ;
(2) By thickened pleura, &c. ;
(3) By some obstruction to the entrance of air into the lungs, &c. ;

All of these cause the sound to be less distinct.

Analysis of cavernous resp.

Inspiration.

Duration : shorter than in normal vesicular respiration because it is deferred ; but it varies in different cases.

Intensity : greater than in normal vesicular respiration in the sense of volume.

Pitch : lower than in normal vesicular respiration ; but it varies with the size of the cavity, tension of its walls, &c.

Quality : blowing, giving the idea of air passing into a hollow space.

Expiration :

Duration : as long as or longer than in inspiration.

Intensity : less than in inspiration.

Pitch : lower than in inspiration.

Quality : blowing, giving the idea of air passing out of a hollow space.

Significance of cav. resp. It signifies the existence of a pulmonary cavity communicating with a bronchial tube.

Disease. It occurs in pulmonary tuberculosis, 3d stage.

V. Amphoric Respiration :

This is the respiratory sound or murmur heard over a jug-shaped pulmonary cavity having hard, smooth, walls, and communicating by a large mouth or opening with a bronchial tube. The cavity must be empty or contain but little fluid.

It sounds like blowing across or into the mouth of an empty jug or bottle.

It is modified :

(1) By overlying structures as bones, muscles, &c.;

(2) By thickened pleura ;

(3) By some obstruction to the entrance of air.

All of these cause the sound to be less distinct.

Analysis of amphoric resp.:

Inspiration :

Duration, Intensity, and Pitch, depend on the size of the cavity and the tension of its walls.

Quality : Amphoric (jug-like).

Expiration :

Duration, Intensity, and Pitch, depend on the size of the cavity and the tension of its walls.

Quality : Amphoric (jug-like).

Significance of amphoric resp. It signifies the existence of an amphoric pulmonary cavity, as above described.

Disease. It occurs in pulmonary tuberculosis, 3d stage.

VI. Emphysematous Respiration. (Fig. 5).

This is the respiratory sound or murmur heard over emphysematous lung tissue—that is, lung tissue in which the air vesicles are permanently over distended, or there is air in the pulmonary interstitial tissue.

It is much less intense than normal vesicular respiration, and is sometimes even absent or inaudible.

Inspiration is shorter than normal, as it is deferred—

i. e., the first part is not heard, being too feeble—because the air has been passing in for some time when the sound begins.

Expiration is prolonged from weakening of the expiratory forces. The causes of this weakening are:—

(1) The lung tissue has lost its resiliency, the air vesicles being permanently dilated;

(2) The costal cartilages have lost their elasticity, the ribs being permanently elevated;

(3) The diaphragm is permanently depressed.

Hence the sound of dilatation during inspiration does not begin until the already distended air vesicles are nearly full; expiration takes much longer to empty the lung, as the vesicles are inelastic and larger than normal. Inspiration and expiration are continuous.

It is modified:

(1) By overlying structures;

(2) By thickened pleura, &c.;

(3) By mucus in the tubes, &c.

All of these render the sound still less distinct.

Analysis of emphy. resp.

Inspiration:

Duration: somewhat shorter than in normal vesicular respiration, as inspiration is deferred.

Intensity: much less than in normal vesicular respiration.

Pitch: lower than in normal vesicular respiration usually.

Quality: less vesicular than in normal vesicular respiration.

Expiration:

Duration: longer than in inspiration, as expiration is prolonged owing to weakening of the expiratory forces. If asthma is present expiration will be four times as long.

Intensity : varies, generally greater than in inspiration.

Pitch : lower than in inspiration.

Quality : blowing.

Significance of emphy. resp. It signifies either a dilated condition of the air vesicles or air in the pulmonary interstitial tissue.

Disease. It occurs in pulmonary-emphysema either with or without asthma.

VII. VESICULO-CAVERNOUS RESPIRATION :

This a mixture of normal vesicular and cavernous respirations, and is caused by the presence of a pulmonary cavity, with normal healthy pulmonary tissue around or near it.

VIII. CAVERNO-BRONCHIAL RESPIRATION :

This is a mixture of cavernous and bronchial respirations, and is caused by the presence of a small pulmonary cavity having considerable solidified lung tissue around or near it.

VOCAL RESONANCE.

This is the sound heard over the respiratory apparatus during the act of speaking.

It is obtained or heard over the whole respiratory apparatus by the application of the ear or stethoscope or phonendoscope to that part of the body, while the patient is made to count slowly "one," "two," "three," &c. It is best that the patient should count in a low whisper.

It is caused by the action or vibration of the vocal cords assisted by the lips, cheeks, tongue, and palate. It therefore has its origin in the larynx and is *conveyed* down through the trachea and bronchial tubes to the air vesicles. On reaching the bronchial tubes the sound begins to be divided up and distributed to the tubes as they divide and ramify, the divisions becoming smaller

and smaller until they are diffused, refracted, and scattered in the air cells. It has a certain intensity which is normal and typical.

If the larynx, trachea, or bronchial tubes, have their calibre diminished (as described in the study of respiratory sounds, page 75), the vocal resonance is *obstructed* on its way, not as much of it reaches the lung tissue, and its intensity is said to be *diminished.*

When the lung contains more air than normal, as when the air cells are overdistended or there is air in the pulmonary interstitial tissue, the tubes remaining the same, the sound is still more diffused, refracted and scattered, and its intensity is also *diminished.*

Exception.—In the case of a pulmonary cavity communicating with a bronchial tube the intensity is *greater* in the sense of volume, although there is more air present. This is due to the cavity admitting a larger volume of sound.

Should the air vesicles be filled up and the lung tissue solidified by inflammatory exudate or tubercle, the tubes remaining normal, the sound is caught up or received from the bronchial tubes without being diffused, &c., and is *conducted* directly from the tubes by the solid lung to the chest wall. Its intensity is then said to be *increased.*

If, however, the tubes and vesicles are normal, but something intervenes between the lung and chest wall (as thickened pleura, fluid, or air, in the chest cavity), so as to *intercept* or *interrupt* the sound before it reaches the walls of the chest, very little or no sound at all will be heard and its intensity is said to be *diminished* or the sound may be *absent* altogether, depending on the thickness of the pleura or amount of fluid or air.

Sometimes, in chronic pleurisy, strings or bands of

adhesions form and extend between the lung and chest wall, and the vocal resonance will be *transmitted* from the one to the other, even though there may be something intervening, just as sound is transmitted along a telephone wire.

We see then that vocal resonance is subjected to different conditions and contingencies in the normal and abnormal subject, thus :

In the normal subject this sound arrives at the chest walls by,

(1) Convection or carrying along the tubes, and by
(2) Refraction or diffusion in the air cells.

In the abnormal subject this sound may be subjected to

(1) Obstruction in the tubes :
(2) Still greater refraction or diffusion in the air cells :
(3) Conduction by solidified lung tissue :
(4) Interruption or interception between the lung and chest wall :
(5) Transmission by strings or bands of adhesion.

"Vocal Resonance" is a general term used for the sound heard during the act of speaking ; but of this there are two kinds. It is called,

Voice Sound, if only the sound of the voice is heard without recognition of each articulate word ; and

Speech Sound, when articulate speech or each separate word can be distinguished. It is not meant that every word can be thus recognized, but only short words as "one", "two", "three", &c., or short syllables.

Vocal Resonance differs very much according as the larynx, trachea, or chest, are examined, and also according as these organs are in a healthy or diseased condition.

The suffix —*phony* is used as the terminal portion of the different varieties of voice sound, while the suffix —*loquy* is employed as the termination of the different kinds of speech sound.

This gives rise to the following varieties of vocal resonance (i. e., Voice and Speech Sounds):

Laryngophony or Laryngeal Voice :
Laryngiloquy or Laryngeal Speech :
Tracheophony or Tracheal Voice :
Trachiloquy or Tracheal Speech :
Pectorophony or Chest Voice :
Pectoriloquy or Chest Speech.

The study of laryngophony, laryngiloquy, tracheophony, and trachiloquy, is of so little moment that they will likewise be dismissed without further mention than to say that tracheophony and trachiloquy resemble bronchophony and bronchiloquy, except that they are more intense than the latter, owing to the larger size of the trachea. This leaves for consideration Pectorophony and Pectoriloquy.

Pectorophony and Pectoriloquy, the Voice and Speech Sounds, or Vocal Resonance, heard over the chest, are likewise divided, according to the part examined, (i. e. air vesicles or bronchial tubes) and the healthy or diseased condition of that part (i. e. whether there is pulmonary solidification or a pulmonary cavity) into the following varieties :

Normal Pectorophony or Normal Chest Voice :
Normal Pectoriloquy or Normal Chest Speech :
Bronchophony or Bronchial Voice :
Bronchiloquy or Bronchial Speech :
Cavernophony or Cavernous Voice :
Cavernilоquy or Cavernous Speech :
Amphorophony or Amphoric Voice :
Amphoriloquy or Amphoric Speech :
Aegophony or Goat's Voice.

All of these sounds must be studied with reference to their duration, intensity, pitch, and quality as compared with normal pectorophony and pectoriloquy. This constitutes the analysis of vocal resonance.

The term pectoriloquy, literally, chest speech, was formerly used for the vocal resonance heard over pulmonary cavities, as it was thought that only over cavities could the articulate words of a patient be heard. But it is now known that this sign can be obtained over perfectly healthy chests, especially over those with thin walls and a loud respiratory murmur, as among women and children. It therefore does not indicate the presence of a pulmonary cavity, as the older writers claimed. Their reasoning was that if the words could be distinguished there was necessarily a pulmonary cavity.

The different speech sounds are due to the same causes and produced under the same conditions as the corresponding voice sounds. Therefore the different varieties of the former will not be separately discussed, as it would be merely a repetition of what will be said of the latter.

I. Normal Pectorophony (= Vesicophony) or Normal Chest Voice :

This is the voice sound or vocal resonance heard over normal healthy air vesicles without recognition of each articulate word. It is a distant, diffused, indistinct, buzzing, low pitched, sound, caused by the diffusion of the voice sound in the air cells.

Analysis :—

Duration : typical, somewhat long, but varies in different healthy individuals.

Intensity : typical, somewhat great, but varies in different healthy individuals according to the character of the voice and condition of the chest walls.

Pitch : typical, and somewhat low.

Quality : distant, diffused, indistinct, buzzing.

It is obtained or heard over the greater part of the chest, wherever there is normal, healthy, lung tissue ; but it is *modified* in different ways, thus :—

(1) By overlying structures, such as bone, muscle, fat, &c., (the scapula, pectoral muscles, &c.), which even in health render the sound less distinct.

(2) By other internal organs, such as the heart, liver, &c., which encroach upon the lung space.

(3) By the character of the voice ; a loud, low-pitched, harsh, voice, other things being equal, yielding more intense pectorophony than a high-pitched, weak, voice ; for this reason

In men, normal pectorophony is more intense than in women :

In adults, normal pectorophony is more intense than in children :

In the aged,

(4) By the condition of the chest walls.

Thin chest walls yield more intense pectorophony than thick.

It is typical in the left subclavicular region in health, as the vocal resonance of this region is taken as the type with which that of the rest of the chest and also of diseased conditions is compared.

Significance ; It signifies a normal, healthy, condition of the air vesicles or lung tissue.

Variations in Normal Pectorophony. These are :— Increased Pectorophony, Diminished Pectorophony, and Absent Pectorophony.

(1) Increased, Exaggerated (in intensity), Pectorophony (Megophony) occurs both in health and disease :—

In health, it is heard on the right side of the chest, especially in the right subclavicular region, because the right primitive bronchus being the larger admits a larger volume of voice sound into the right lung than into the left.

In disease, it is heard over partially solidified lung tissue, owing to the better conducting power of the latter.

It is nearer, less diffused and more distinct and intense (in the sense of concentrated amount) than normal.

Disease: It occurs in incipient pulmonary tuberculosis (1st stage).

(2) Diminished, Weakened (in intensity), Pectoriloquy (Microphony), occurs both in health and disease.

In health, it is due to overlying structures, such as bone, muscle, fat, &c.

In disease, it is due to

(a) Some obstruction to the entrance of the voice sound into the lungs, as in:
Affections of the larynx:
Foreign bodies in the air passages:
Pressure by tumors:
Spasm of a bronchial tube:
Stricture of a bronchial tube or trachea:
Thickened mucous membrane:
Mucus, pus, blood, polypi, &c., in the air passages.

(b) Greater capacity of lung tissue to break up, diffuse, and scatter the voice sound (= increased refractive power of the lung), before it reaches the chest wall, as in over-distention of air vesicles or interstitial tissue; e. g., emphysema.

(c) Some mechanical interference with the expansion of the air cells, as in the case of ;
Fluid or air in moderate amount in the pleural cavity.
Tumor compressing the lung, &c.

(d) Deficient respiratory action, as in ;
General debility :
Impairment of nervous force: e. g., paralysis ;
Local pain: e. g., pleurisy, pleurodynia, intercostal neuralgia, broken rib, &c.

(3) Absent Pectorophony. This is due to some obstacle between the lung and chest wall that intercepts the sound entirely ; e. g., a very thick pleura, fluid or air in large amount.

II. Broncophony or Bronchial Voice.

This is the voice sound or vocal resonance heard over normal, healthy, bronchial tubes, without recognition of each articulate word. It is the sound that is made in the bronchial tubes and that would be heard if the lung tissue could be removed and the bronchial tubes brought in direct contact with the chest walls.

It is obtained or heard both in health and disease.

In health, it occurs in the interscapular region because the primitive bronchi are there, but especially on the left side as the left primitive bronchus comes nearer the surface behind than the right.

In disease, it occurs over solidified lung tissue, because the sound is conducted directly from the tubes to the chest walls by the solidified lung, and is not diffused and scattered in the air cells, as the latter are filled up with solid material.

It is a near, concentrated, distinct, tubular, and high-pitched sound, because it is not diffused, refracted, and scattered in the air cells (they being filled up); but it is

conducted directly from the tubes to the chest walls by the solid lung tissue. It is tubular, because it is the sound that comes directly from the tubes, and high-pitched because it passes from one medium to a denser medium with shorter vibrations (see note, p. 85).

Bronchophony resembles tracheophony, but is less intense; it also sounds like the voice when spoken through a tube.

It is more intense than normal pectorophony in the sense of concentrated amount.

It is modified (in disease):—

(1) By some obstruction in the air passages to the entrance of air, such as laryngeal affections, stricture, mucus, swollen mucous membrane, spasm of a tube, compression by a tumor, &c.;

(2) By thickened pleura, fluid in the chest cavity, &c.

All these may act by rendering bronchophony distant, or weak, or altogether absent, or suppressed.

Analysis:

Duration: shorter than in normal pectorophnoy, on account of shorter vibrations, the sound having passed from one medium to a denser.

Intensity: greater than in normal pectorophony in the sense of concentrated amount.

Pitch: higher than in normal pectorophony because of shorter vibrations.

Quality: tubular (especially when whispered), near, concentrated, and distinct.

Significance: It signifies completely solidified lung tissue, when heard anywhere else than over the interscapular region.

Diseases: It occurs in

Lobar Pneumonia, 2d and 3d stages:

Pulmonary Tuberculosis, 2d stage.

III. Cavernophony or Cavernous Voice.

This is the voice sound or vocal resonance heard over a pulmonary cavity communicating with a bronchial tube and giving cavernous respiration.

It is a blowing, sepulchral, sound, that suggests for the patient an early sepulchre or burial; and such is generally the sequel. It is more intense than normal pectorophony, in the sense of volume.

Analysis:

Duration: varies with the size of the cavity.

Intensity: greater than in normal pectorophony, in the sense of volume.

Pitch: lower than in normal pectorophony; but it varies with the size of the cavity and tension of its walls (the latter depending on the amount of solidified tissue).

Quality: sepulchral and blowing.

Significance: It signifies the presence of a pulmonary cavity communicating with a bronchial tube.

Disease: It occurs in pulmonary tuberculosis, 3d stage.

IV. Amphorophony (Amphoric or Jug Voice).

This is the voice sound or vocal resonance heard over an amphoric pulmonary cavity: i. e., a cavity having hard, smooth, unyielding, walls and communicating by a large mouth with a bronchial tube. It must be empty or contain but little fluid. This kind of cavity imparts to the sound an echo which makes it resemble the sound of the voice in an empty jug. The hard, unyielding, character of the walls of this cavity is due to its being surrounded by solid lung tissue.

Analysis:—

Duration, Intensity, and Pitch depend on the size of the cavity and the tension of its walls.

Quality: amphoric, metallic, ringing.

Significance: It signifies the presence of an amphoric or jug-like pulmonary cavity.

Disease: It occurs in pulmonary tuberculosis, 3d stage.

V. AEGOPHONY (Goat's Voice).

This is the voice sound or vocal resonance heard over, and caused by, the vibration of fluid somewhere in the chest.

The fluid may be situated in the pleural cavity, in a pulmonary cavity, or in a bronchial tube; or it may be a thin stratum of fluid encapsulated between a compressed lung and the chest wall. The fluid is generally small in amount, otherwise it cannot be thrown into vibration.

Sometimes this sound is heard in solidification of the lung.

Aegophony is nothing more than distant, tremulous, Bronchophony—distant or weakened on account of some intervening medium, as a thickened pleura, and tremulous from the presence of fluid thrown into vibration.

It is heard most commonly at the lower angle of the scapula, along the upper border of the fluid, in pleuritic effusion.

It has a *nasal quality* and is more of a clinical curiosity than of any real value, as the aspirating needle may be used with more certainty in determining the presence of fluid.

Significance. It signifies the presence of fluid in small amount in the chest cavity somewhere.

Diseases: It occurs in,

Pleurisy with effusion (hydrothorax):

Bronchitis:

Lobar pneumonia.

ADVENTITIOUS SOUNDS.

Adventitious sounds are new and abnormal sounds produced in the body by disease, and are not modified normal sounds. They are sounds that are not natural, do not belong to the healthy body, and have no analogue in health.

Varieties of Adventitious Sounds ;—these are :—

(1) Friction Sounds ;
(2) Splashing Sounds ;
(3) Râles ;
(4) Heart Murmurs ;
(5) Aneurismal Bruit.

The last two will be discussed in the chapter on heart murmurs.

I. Friction Sounds.

These are creaking, clicking, churning, grating, grazing, rasping, rubbing, rumbling, sounds, caused by the rubbing together of roughened pleural or pericardial surfaces.

In health the pleural and pericardial surfaces are perfectly smooth and moistened with a lubricating secretion called synovia or synovial fluid, so that they glide noiselessly over each other during respiration and heart action.

In inflammation of the pleura or pericardium, the surfaces become dry (from deficient secretion), rough (from exudation), or agglutinated (by the exudate), and the friction sound is heard. Hence, the dryness, roughness, and agglutination are due to inflammation, and friction sounds are divided into pleuritic and pericardial.

(1) Pleuritic Friction Sounds.

These are described as creaking (like new leather), crepitating, grating, grazing, rasping, rubbing, rumbling, caused by the rubbing together of roughened pleural surfaces.

They resemble the sound made by the creaking of new leather or treading in deep, wet, snow.

They are:

Superficial:

Confined to a small area of the chest:

Sometimes jerky:

Uninfluenced by coughing:

Usually interrupted, i. e., several sounds may occur during one inspiration or expiration or both;

Most frequent in the lateral portions of the chest.

They are heard:

Anywhere over the chest, but most frequently in the lateral portions of the chest, and chiefly on inspiration, but also on expiration.

They disappear when the chest walls are made immovable or fixed and sometimes cause fremitus on palpation.

If the pleural surfaces are adherent or separated by fluid in the chest cavity, the friction sound will be absent.

Significance: It signifies roughening of the pleura.

Disease: It occurs in pleurisy.

(2) Pericardial Friction Sounds.

These are described as creaking (like new leather), clicking, churning, crumpling (like parchment), grating, grazing, to-and-fro-rubbing, scraping, scratching sounds, caused by the rubbing together of roughened pericardial surfaces.

They are:—

Superficial:

Single or double:

Variable (sometimes heard and sometimes not):

Limited to the cardiac region:

Sometimes intermitting:

Sometimes jerky:

Increased in extent by external pressure (ear or stethoscope) and bending forward:

Made louder by pressure, sitting, bending forward; generally, louder on inspiration, sometimes on expiration;

Independent of normal heart sounds, i. e. not fixed.

They are heard:—

Over the precordial region of the chest:

Best over the right ventricle and over the base of the heart:

During systole or diastole or both:

Generally not associated with the phases of the heart's action.

They follow the movements of the heart and sometimes cause fremitus on palpation.

If the pericardial surfaces are adherent or separated by fluid in the pericardium the friction sound will be absent.

Significance: It signifies roughening of the pericardium.

Disease: It occurs in pericarditis.

II. Splashing Sounds:—

These are sounds caused by the splashing of fluid in a cavity that contains both fluid and air (or gas), and are elicited by succussion and auscultation combined (see succussion).

The splashing sound of the fluid is easily recognized.

They are obtained over any part of the body in which there is a cavity containing both fluid and air (or gas).

Significance. It signifies the presence of both fluid and air in a cavity.

Diseases—It occurs in pneumohydrothorax, pneumopyothorax, pulmonary cavities, &c.

III. Rales or Rhonchi (Rattles).

These are rattling sounds caused by the breaking of air by or through impediments in the air passages (i. e., the larynx, trachea, bronchi, air vesicles, pulmonary cavities, &c. All râles may cause fremitus on palpation.

Varieties of Râles.

Râles have been variously grouped and classified; e. g., according to the organ n which they are produced or according to the character of the sound produced.

According to the *organ* they may be (Da Costa):—

(A) Laryngeal ;—Dry and Moist, produced in the larynx.

(B) Tracheal ;—Dry and Moist, produced in the trachea.

(C) Bronchial;—Dry and Moist.

(1) Dry ; (a) Sonorous, produced in the large bronchi.

(b) Sibilant, produced in the small bronchi.

(2) Moist; (a) Large Bubbling, produced in the large bronchi.

(b) Small Bubbling, produced in the small bronchi.

(D) Vesicular : Moist :

(a) Crepitant (crepitation), produced in the air vesicles.

(b) Crackling, produced in the air vesicles.

(E) Cavernous : Moist :

Gurgling, produced in pulmonary cavities.

According to the *character of the sound* they may be (Page):—

(1) Dry :
  (a) Stridulous (Laryngeal and Tracheal = Stridor), produced in the larynx and trachea.
  (b) Sonorous, produced in the large bronchi.
  (c) Sibilant, produced in the small bronchi.
(2) Moist :
  (a) Laryngeal, produced in the larynx.
  (b) Tracheal, produced in the trachea.
  (c) Mucous, produced in the large bronchi.
  (d) Submucous, produced in the medium-sized bronchi.
  (e) Subcrepitant, produced in the smallest bronchi.
  (f) Crepitant, produced in the air vesicles.
  (g) Mucous click, produced in a small bronchus.
  (h) Gurgles, produced in pulmonary cavities.
  (i) Metallic tinkle, produced in amphoric pulmonary cavities.
  (j) Intra-pleural moist râles, produced between the pleural surfaces.
(3) Indeterminate (origin and mode of production unknown).

The last mentioned classification, according to the teaching of Dr. R. C. W. Page, is adopted here.

DRY RALES.

These are caused by a narrowing of the calibre of the air passages, as by spasm, stricture, pressure by tumors, swollen mucous membrane, tough mucus, and also by paralysis of the vocal cords. The air in passing the narrow point has to travel faster than anywhere else. The faster air travels, the more sound it makes (as winds, &c.) Thus dry râles are produced in the larynx, trachea, and bronchi.

Varieties of dry râles : These are,

Stridulous Rales (Stridor).

Sonorous Rales.
Sibilant Rales.

(1) Stridulous Rales (= Laryngeal and Tracheal Dry Rales = Stridor):
These are coarse, hoarse, vibrating sounds, produced in the larynx or trachea.
They are caused by a narrowing of the calibre of the larynx and trachea, and are conveyed all over the chest; but they are loudest at the site of their production.
They are heard either on inspiration, expiration, or both.
Significance: A narrowing of the calibre of the larynx, or trachea.
Diseases:
Croup (with false membrane):
Polypi in larynx or trachea:
Whooping cough:
Tumor pressing on larynx or trachea (especially on recurrent laryngeal nerve):
Oedema of glottis or trachea:
Spasm of the glottis (Laryngismus stridulous):
Inflammatory exudate in larynx or trachea:
Stricture of larynx or trachea:
Swelling of mucous membrane.

(2) Sonorous Rales:
These are loud, dry, low-pitched, snoring, sounds, produced usually in the larger bronchi.
They are caused by a diminution of the calibre of the tubes as by;
Spasm of their muscular coat:
Stricture due to old inflammation or ulceration:
Pressure by tumors from without:
Swelling of mucous membrane:
Tough mucus vibrating in the tubes, &c.

They are heard either on inspiration, expiration or both, and change on coughing.

Significance: A narrowing of the calibre of the tubes.

Diseases:

Bronchitis (early or dry stage):

Spasmodic asthma:

Stricture:

Tumors, &c.

Note: Sonorous Rales may also be produced in the larynx and trachea, if their calibre is diminished enough.

They are then likewise heard either on inspiration, expiration or both, are conveyed all over the chest, and are loudest at the site of their production.

The same diseases that produce stridulous rales in the larynx and trachea may also produce sonorous rales in the larynx and trachea, provided the calibre of the latter is narrowed enough.

(3) Sibilant Rales.

These are loud, dry, high-pitched, whistling, sounds, produced usually in the smaller bronchi. They are caused by a diminution of the calibre of the tubes, as by,

Spasm of the muscular coat:

Stricture due to old inflammation:

Pressure by tumors from without:

Swelling of mucous membrane:

Tough mucus vibrating in the tubes, &c.

They are heard either on inspiration, expiration or both, and change on coughing.

Significance: A narrowing of the calibre of the tubes.

Diseases:

Bronchitis (early or dry stage):

Spasmodic asthma :
Strictures :
Tumors, &c.

Note. Sibilant Rales may also be produced in the larynx, trachea, and larger bronchi, provided their calibre is diminished enough.

They are then likewise heard either on inspiration, expiration or both, are conveyed all over the chest, and are loudest at the site of their production.

The same diseases, that produce stridulous rales in the larynx aud trachea, and sonorous rales in the larger bronchi, may also produce sibilant rales in the same localities, provided the calibre is narrowed enough.

MOIST RALES.

These are caused by the presence of fluid, as mucus, serum, pus, blood, in the air passages. The air in passing or bursting through the fluid gives rise to bubbling and other moist sounds, which are produced in the larynx, trachea, bronchi, air vesicles, and pleural cavity.

Varieties of moist rales. These are :—

Laryngeal Rales ;
Tracheal Rales ;
Mucous Rales ;
Submucous Rales ;
Subcrepitant Rales ;
Crepitant Rales ;
Mucous Click ;
Gurgles ;
Metallic Tinkle ;
Intrapleural Moist Rales.

Note. The term "mucous" is applied to any kind of large, moist, rale, whether it be due to mucus, serum, pus or blood. So also the term "submucous" is simi-

larly used for smaller, moist rales, no matter what the fluid.

(1) Laryngeal and Tracheal Moist Rales. :

These are moist, bubbling, sounds, produced in the larynx and trachea.

They are caused by air bursting through fluid, as mucous, serum, pus, blood, in the larynx and trachea and are conveyed all over the chest, but are loudest over the site of their production.

They are heard either on inspiration, expiration, or both, and change or disappear on clearing the throat.

When they occur in the trachea just before death they are called "the death rattle."

Significance: They signify fluid in the larynx or trachea.

Disease:

(2) Mucous Rales:

These are large, moist, bubbling, sounds, produced in the larger bronchi, and resemble the noise made by sucking up through a tube a few drops of water mingled with cracked ice in the bottom of a glass.

They are caused by air bursting through fluid, as mucus, serum, pus or blood, in those bronchi, are attended by expectoration, and change about on coughing.

They are heard either on inspiration, expiration, or both, and if not present at first they may be developed by coughing.

Significance: They signify fluid in the larger bronchi.

Diseases :
Bronchitis :
Pulmonary tuberculosis :
Pulmonary hemorrhage :
Pulmonary abscess (after it has burst).

(3) Submucous Rales :

These are smaller, moist, bubbling, sounds, produced in the medium sized bronchi, and resemble the noise made by sucking up through a small tube a few drops of water mingled with cracked ice in the bottom of a glass.

They are caused by air bursting through fluid, as mucus, serum, pus, or blood, in those bronchi, are attended by expectoration, and change about on coughing.

They are heard either on inspiration, expiration, or both, and if not present at first they may be developed by coughing, just as the mucous rales.

Significance : They signify fluid in the medium sized bronchi.

Diseases :
Bronchitis :
Pulmonary tuberculosis :
Pulmonary hemorrhage :
Pulmonary abscess :

(4) Subcrepitant Rales :

These are the finest, moist, bubbling or separating, sounds produced in the smallest (finest, ultimate) bronchi (bronchioles),—

They are caused in two ways :—

(a) By the forcible separation of agglutinated tube walls, the tubes being agglutinated by inflammatory material ; or

(b) By air bursting through fluid, as mucus, serum, pus, blood, in these bronchi.

They are heard chiefly on inspiration, as inspiration is more forcible and hence the fluid is overcome with more force; but they may also be heard on expiration. When due to separation of tube walls, they occur only on inspiration. They are attended by expectoration and change about less easily on coughing.

Significance: They signify agglutination of, or fluid in, the finest bronchial tubes.

Diseases:

Capillary bronchitis:

Lobar pneumonia, 3d stage (they are then due to secondary bronchitis and liquefying exudate):

Pulmonary tuberculosis, any stage, but particularly the first.

Pulmonary hemorrhage:

Pulmonary oedema.

(5) Crepitant Rales:

These are very fine, uniform, crackling sounds, produced in the air cells, and resemble the sound made by throwing salt on the fire or by rubbing a lock of hair just above the ear between the thumb and finger.

They are caused in two ways:—

(a) By the forcible separation of agglutinated cell walls, the walls being agglutinated by inflammatory material, as in lobar pneumonia, or

(b) By the agitation of thin fluid in the air cells by the air, as in pulmonary oedema. In this the rales are louder and more liquid than in pneumonia.

They are heard only at the tip end of inspiration, are attended by expectoration, and are unchanged by coughing.

Significance : They signify agglutination of cell walls or thin fluid in the air cells.

Diseases :

Lobar pneumonia (1st stage, in which they are due to separation of cell walls) :

Lobar pneumonia (3d stage, in which they are the "rale redux") :

Pulmonary tuberculosis (any stage) :

Pulmonary oedema (in which they are due to the agitation of thin fluid in the air cells).

Note. The crepitant rale occurs in the 1st stage of lobar pneumonia. It disappears as soon as solidification occurs, which happens in the 2d stage, and returns again in the 3d stage when the solid exudate begins to dissolve and liquefy. It is then called the "rale redux" or rale that has returned, and must not be confounded with the subcrepitant rale, that also occurs in the 3d stage of pneumonia and that is due to secondary bronchitis or liquefying exudate.

(6) Mucous Click :

This is a single, fine, high-pitched, moist, click, produced in a fine bronchial tube, and resembles an isolated subcrepitant rale.

It is caused by the sudden passage of air through a fine bronchial tube obstructed by pressure from without (as tubercle) or by viscid mucus within. It is heard at or near the end of inspiration over partial solidification of lung tissue and is unchanged on coughing.

Significance : It signifies obstruction of a fine bronchial tube.

Disease : Pulmonary tuberculosis, 1st stage.

(7) Gurgles :

These are large, moist, bubbling, sounds, produced in a pulmonary cavity containing fluid and

air and communicating with a bronchial tube. The sounds will be large or small, high or low pitched, according to the size of the cavity and amount of solid tissue around it.

They are caused by air bursting through fluid, as mucus, serum, pus, blood, &c., in the cavity. They are heard chiefly and more loudly on inspiration, because the latter is more forcible than expiration, and because the current and sound are directed toward the ear of the listener in inspiration ; but they are also heard on expiration, are attended by expectoration, and are unchanged on coughing.

If the cavity is full of fluid or entirely empty no gurgle will be heard ; or if the opening into the cavity is stopped by a plug of mucus or clot of blood, preexisting gurgles cease, but return when the plug is removed by coughing.

Significance : It signifies a pulmonary cavity containing fluid and air and communicating with a bronchial tube.

Disease : Pulmonary tuberculosis, 3d stage.

(8) METALLIC OR AMPHORIC TINKLE :—

This is a metallic, amphoric, ringing, sound, produced in several ways, thus :—

(a) It may be due to the bursting of air through a small amount of viscid fluid in an amphoric, pulmonary cavity communicating with a bronchial tube, which opens into or under the fluid, thus producing an explosion of bubbles.

(b) It may be due to the vibration of viscid mucus in an amphoric pulmonary cavity communicating with a bronchial tube.

(c) It may be due to the bursting of bubbles (formed by inspiration or by shaking the pa-

tient) in the pleural cavity, containing both fluid and air.

(d) According to Walshe, it may be due to the proximity of the sound to a cavity that echoes the sound.

This sound is probably never due to the dropping or dripping of fluid in a pulmonary cavity or in the plural cavity, as there is never sufficient room or distance for the drops to produce such a sound. The essential factors though in its production are, an amphoric cavity which acts as a resonant chamber, and a small amount of viscid fluid. Not all the bubbles will produce metallic tinkle, but only those that are in consonance with the echo of the cavity.

Metallic tinkle is then a phenomenon of the "consonance of sounds." (Page).

It is heard most distinctly on inspiration and is not constant, but appears and disappears.

It sometimes disappears on coughing, or may be developed by coughing or speaking.

Significance: It signifies the presence of an amphoric cavity acting as a resonant chamber and a small amount of viscid fluid.

Disease: Pulmonary tuberculosis, 3d stage.

(9) Intra-pleural Moist Rales:

These are sounds produced in the pleural cavity, and resembling moist rales (both laryngeal, tracheal, bronchial, and vesicular, mucous, submucous, subcrepitant and crepitant).

(Some writers claim that the crepitant and subcrepitant rale is always intra-pleural.)

They are caused by the presence of a viscid, glutinous, secretion on the pleural surfaces, due to perverted nutrition of the membrane.

They are heard chiefly on inspiration, not attended by expectoration, unchanged by coughing, and are superficial, peripheral, localized and unilateral.

Significance: They signify the presence of viscid glutinous, secretion on the pleural surfaces.

Disease: Perverted nutrition of the pleurae.

INDETERMINATE RALES.

These include all other rales not embraced in the foregoing classes.

They are crackling, crumpling, partly moist and partly dry, sounds produced, it is not known exactly where, i. e., whether they are of intra-pleural, pulmonary, or bronchial origin.

They are heard on inspiration, expiration, or both.

Significance:

Disease: Pulmonary tuberculosis, any stage. Flint says they occur in the 1st stage.

HEART SOUNDS.

These are both normal and abnormal.

NORMAL HEART SOUNDS (Page).

These are the sounds made by the heart during the performance of its function, when the organ is in a normal condition. They are two in number designated in physiology as the first and second sounds of the heart.

The First Sound is a long, dull, booming, low-pitched, sound, heard best at the apex, where it sounds like *ub*. At the base it is shorter, sharper, and higher pitched, and sounds like *up*. It is also called the apex, inferior, systolic, sound, because it is heard best at the apex or lower part of the organ and occurs during systole.

The causes of the first sound are :

(1) Contraction of the muscular fibres of the two ventricles ("muscle sound") (Laudois);
(2) Closure, tension, and vibration, of the mitral and tricuspid valves ;
(3) Tension and vibration of the chordae tendineae ;
(4) The rush of blood out of the ventricles ;
(5) The apex beat against the chest wall.

The Second Sound, is a short, sharp, high-pitched, sound heard best at the base where it sounds like *tâ*.

It is also called the basic, superior, diastolic, sound, because it is heard best at the base or upper part of the organ and occurs during diastole.

The cause of the second sound is :—

The closure, tension, and vibration, of the aortic and pulmonary valves.

Each separate valve makes a separate and distinct sound of its own, but as the two auriculo-ventricular valves open and close together, their sounds occur together and cannot be distinguished apart ; so also do the semilunar valves act together or nearly so and their sounds occur together or nearly so. Thus we have practically two sounds instead of four.

At the ~~base~~ apart the two sounds resemble the syllables *ub tâ* ; while at the ~~apex~~ base they resemble the syllables *up tâ*.

Rhythm of the heart is the repetition of all the successive phenomena which go to make up what is termed a complete circuit or revolution, each one of which is divided into a first sound, first rest, second sound, and second rest (Page).

Suppose a revolution to be 10-8 long, then,

The first sound wonld be 4-8,
The first rest 1-8,
The second sound 2-8,
The second rest 3-8 long.

The heart's rhythm may be imitated by striking on a table with the palmar aspect of the wrist for the first sound and the tip of the middle finger of the same hand for the second sound, the proper intervals for the periods of silence being observed (Page).

ABNORMAL HEART SOUNDS.

("Heart Murmurs").

These are adventitious sounds heard in connection with the heart during the performance of its function in addition to or in the place of the normal sounds.

The causes of heart murmurs are :—

I. Organic lesions and

II. Inorganic affections.

I. Organic Lesions may affect the valves, orifices of the valves, or walls of the ventricles.

They are :—

(1) Inflammatory granulations or vegetations on the valves, on the walls of the ventricles, or on the inside of the aorta.

These may project into the blood stream and offer an obstruction or impediment to its flow. The blood in flowing over or against this obstruction makes a noise just as the water of a small stream makes a murmuring or babbling sound in flowing over stones in its bed ("babbling brook"). If the granulation or vegetation is situated on the edges of the valve segments it may prevent their perfect closure and thereby cause a leak or regurgitation of blood through the aperture caused by the lesion, and we will have, besides the direct normal current flowing in the proper direction, an indirect current flowing in the opposite direction. This indirect current being propelled with great force through the narrow aperture gives rise likewise to a murmur.

(2) Inflammatory narrowing or constriction of the cardiac orifices or of the aorta just beyond the valve. The blood in passing this narrow point is compelled to flow much faster than in the normal condition. The more rapidly fluids move the more noise they make and hence we have an adventitious sound or murmur developed.

(3) Inflammatory thickening of the valve segments. This would interfere with their perfect closure and allow a regurgitation of blood which would cause the abnormal sound.

(4) Inflammatory adhesions of the valve segments to each other or to the walls of the blood vessels. This would cause either an obstruction or a regurgitation (leak).

(5) Inflammatory roughening of the endocardium. The blood in flowing over the rough surface would give rise to a murmur as in the case of stones in the bed of a stream.

(6) Calcareous deposits on the valves or walls of the ventricles. These act by causing obstruction or regurgitation (as in the case of a granulation, &c.)

(7) Inflammatory roughening or thickening of a chorda tendinea.

(8) Misattachment of a chorda tendinea.

(9) Adhesion of a chorda tendinea to the wall of the ventricle.

(10) Rupture of a valve segment or chorda tendinea.

(11) Congenital aperture in a valve segment.

(12) Twisting of the columnae carneae by inflammation.

(13) Cardiac ventricular aneurism.

In fact any mechanical derangement of the valves or interior of the heart will give rise to an organic murmur.

We see then that these lesions may cause murmurs in several ways, the chief of which are as follows :—

They may obstruct the passage of blood through the orifices in the natural direction, giving rise to an obstructive murmur.

They may interfere with the perfect closure of a valve, thereby causing a leak or regurgitation of blood through the valve in the opposite direction, giving rise to a regurgitant murmur.

They may project from the ventricular wall into the current of blood, giving rise to an intraventricular murmur.

They may project from the wall of the aorta into the blood current or cause a narrowing of the calibre of the aorta, giving rise to an intra-arterial murmur.

The various lesions of the chordae tendineae or columnae carneae, and also cardiac ventricular aneurism, would give rise to intraventricular murmurs.

Causes of organic lesions (Page):

(1) Violence as in lifting, especially in the case of aortic insufficiency.

(2) Endocarditis. This is the most frequent cause, and is due to, rheumatism (most frequently), diphtheria, scarlatina, typhoid fever, measles, syphilis, gout, erysipelas pyaemia, lead poisoning, Bright's disease, surgical injury, &c., or it may be idiopathic.

Endocarditis before birth attacks the right heart and after birth the left heart. It attacks that side of the heart which has the most work to do, but does not always leave traces behind, though it generally does. These may affect the valves, orifices of the valves, or walls of the ventricles, as seen above.

Richardson, of London, says that the reason endocarditis attacks the left heart after birth is that the blood receives a poison in the lungs (after birth) which is taken directly to the left heart and causes endocarditis; and that the poison has lost its virulence before it gets to the right heart. This reasoning is bad as the blood is supposed to be purified in the lungs instead of being poisoned.

II. Inorganic Affections, causing heart murmurs, are, anaemia, neuroses, violent exercise, pressure by the stethoscope, &c.

These cause murmurs by causing perverted action of the blood in the heart cavities, as in anaemia, or perverted action of the heart muscle, as in neuroses, exercise, pressure on the chest wall, &c.

(1) Anaemia causes murmurs by causing weakness and flabbiness of the heart muscle so that it stretches, the cavities becoming larger while the orifices remain the same (this is practically the same as normal cavities with smaller orifices). This gives rise to a vortiginous (eddying) movement of the blood in the ventricles or misdirection of the current. Likewise the papillary muscles may become weak from fatty degeneration, allowing the valves to recoil too far, giving rise to leakage.

Anaemia makes all cardiac murmurs louder, by increasing vibratility of tissue.

(2) Neuroses cause murmurs by causing perverted action of the heart muscle, as in the case of chorea, hysteria, nervousness, epilepsy, alcoholism, tobaccoism, masturbation.

Chorea causes twitching of the columnae carneae, which pulls the valves open thus allowing a leak.

Masturbation causes murmurs by causing anaemia.

(3) Violent exercise, as among athletes, running up stairs, &c., causes murmurs either during or after exertion by exciting the heart to violent action.

(4) Pressure by the stethoscope will cause murmurs sometimes in those with thin, yielding, chest walls, as among children, by forcing the chest wall against the heart (see pericardial friction sound).

From the foregoing it will be seen that the mere presence of a cardiac murmur is no positive sign that the heart is diseased.

The loudness or feebleness of a cardiac murmur does not indicate the amount or gravity of the lesion.

Classification of Cardiac Murmurs.

Heart Murmurs have been variously classified as follows:

I. Organic:
   (1) Endocardial;
   (2) Exocardial.

II. Inorganic or Functional:
   (1) Endocardial;
   (2) Exocardial.

A better classification would seem to be as follows, and this is the one adhered to in this work (according to Page).

I. Organic:—
   (1) Valvular;
   (2) Intraventricular;
   (3) Intraarterial;
   (4) Purring Thrill;
   (5) Cardiac Friction Sounds.

II. Inorganic or Functional :
  (1) Dynamic :
    (a) Anaemic.
    (b) Neurotic.
  (2) Cardio-respiratory.

ORGANIC HEART MURMURS.

These are adventitious sounds heard in connection with the heart during the performance of its function and caused by some organic lesion affecting the valves, orifices of the valves, walls of the ventricles, or walls of the aorta (see p. 119).

Varieties of Organic Heart Murmurs :

These are :

Valvular (most frequent) ;
Intraventricular ;
Intraarterial ;
Purring Thrill ;
Cardiac Friction Sound (this has already been discussed under friction sounds).

VALVULAR MURMURS.

These are organic murmurs produced at one or more valves of the heart and caused by some organic lesion of the valves or orifices. This may give rise to either

Obstruction to the passage of blood in the normal direction through the valvular orifice, or to

Regurgitation or leakage of blood back through the valve which has been kept from closing perfectly.

The kinds of murmurs that may be developed at each valve are Obstructive and Regurgitant according as there is obstruction or regurgition at the valve.

The nomenclature of valvular murmurs then depends not only upon the valves at which they occur, but also upon their production by obstruction or regurgitation at the valves.

This gives rise to the following

Classification or Varieties

of

Valvular Murmurs.

Mitral Obstructive and Mitral Regurgitant Murmurs;
Aortic Obstructive and Aortic Regurgitant Murmurs;
Pulmonic Obstructive and Pulmonic Regurgitant Murmurs;
Tricuspid Obstructive and Tricuspid Regurgitant Murmurs.

Other Names.

These murmurs are likewise called by other names equally as descriptive as the above; e. g.—

Presystolic, Systolic, Diastolic, denoting the time of occurrence with reference to the action of the heart;
Direct and Indirect, denoting the direction in which the current that produces them is flowing;
Insufficient, Reflux, denoting the condition of the valve, i. e., whether it leaks or not;
Constrictive, Stenotic, denoting the condition of the orifice, i. e., whether it is contracted or not;
Apex, Basic, denoting the part of the heart over which the murmur is best heard.

Transmission of Sound.

Solids, liquids, and gases all act as *conductors* of sound, from one point to another; for instance, the sternum may conduct the sounds of the heart from the point at which the heart is almost in contact with it to either end of that bone. Likewise the thick solid wall of the left ventricle may conduct sounds made at the deep seated mitral valve to the apex, at which point it can be heard better than at its seat of development, be-

cause the apex is more superficial. The ribs or chest wall may also take up the sound from the apex and conduct it to the left.

Blood currents, such as the normal, direct, current, or an abnormal, indirect, regurgitant, current, can *convey* sound from one point to another ; for instance, if a sound is developed or made at a deep seated point like the mitral valve it can be taken up by the direct current of blood as it comes through the orifice and brought to the surface at the 4th left costo-chondral articulation, which is the front end of the auriculo-ventricular axis and in line with the blood current. So likewise if there is a leak at the mitral valve giving rise to an indirect or regurgitating current, the sound made at the deep seated valve can be taken up by the regurgitant current and carried to the 8th dorsal vertebra, which is the posterior end of the left auriculo-ventricular axis and in line with the current. At both of these superficial points the sound can be heard better than at the seat of its development, which is deep seated.

A discrimination must be made between the *conduction* of sound by the vibration of the atoms and molecules of a substance (solid, liquid, or gas, bone, muscle, etc.), at rest, and the *conveyance* (carrying) of sound by the mass of that substance in motion (as by a vehicle, blood current, etc.).

Thus, if one end of a cane be held to the ear and the other end be scratched with the finger, the sound is *conducted* to the ear by the vibration of the molecules of the cane which were at rest and were set in motion by the scratching. Or, if the head be immersed in still water and two stones in the hands be struck together, the sound of the striking is *conducted* to the ear by the vibration of the molecules of the still water. Like-

wise, the strains of a musical instrument are *conducted* to the ear by the vibrations of the molecules of air, which are, en masse, at rest.

On the other hand the *conveyance* of sound en masse by the mass of a substance in motion, may be illustrated by a band of music in a wagon, boat, or balloon, the sound becoming more distinct as the vehicle approaches. In this case, the sound is conveyed or carried bodily, as it were.

Transmission is a general term used here with reference either to conduction or conveyance of sound.

The foregoing gives rise to three important laws which will be of use in the study of heart sounds.

Law I. Solids, liquids, and gases, all conduct sound more or less, but solids are better conductors than liquids or gases.

Law II. Blood currents all convey sound more or less from the seat of its development in the direction in which the currents are running.

Law III. Cardiac valvular sounds, normal and abnormal, are transmitted from the valves, at which they are produced, either by the conducting power of some solid (bone or muscle) in proximity or by the conveying power of the blood currents that aid in their production, so as to be heard with greatest intensity at some other point than the point at which they are produced.

Solids in proximity *conduct* the sounds throughout their whole extent.

Blood currents *convey* the sounds in the direction in which the currents are moving.

Solids and Blood Currents both *transmit* the sounds.

The above laws apply with equal force to normal physiological valvular sounds as well as to abnormal valvular sounds ("valvular murmurs"); and a proper appreciation of them enables us to understand why normal valvular sounds and valvular murmurs are heard

with greatest intensity, not at the seat of their development, as we would expect, but at some other point.

Quality.

Heart murmurs of all kinds are generally described as *blowing* in quality (Page and Da Costa) and may be represented by the combination *sh* pronounced as *sh* in ship. They may also be *musical*, *blubbering*, &c. The duration, intensity, and pitch of these sounds are not of sufficient importance to be considered.

Point of Maximum Intensity.

The *Point of Maximum Intensity* of a valvular sound is some point on the chest at which it can be heard more distinctly or loudly than anywhere else.

Any murmur may be so loud as to be heard all over the chest; but each valvular sound has, as a rule, one point at which it may be heard with greater intensity than anywhere else, and it would naturally be supposed that this point would correspond with the seat of development of the sound; for instance at first thought we would expect to hear the valvular sounds most loudly and with the greatest intensity right over the valve at which the sound is produced; but this is not the case, because the valves are generally deep seated and have overlying structures, such as bone, muscle, &c., which muffle the sound and render it less distinct or intense.

Valvular sounds then, normal and abnormal, must be looked for and studied at some other point remote from their seat of development and at which the sounds are more superficial and come nearer the surface.

They are heard with greatest intensity, not over the seat of their development (i. e., over the valves) because the valves are deep seated and the sounds are muffled by overlying structures, but at some other point or

points to which they are *transmitted* either by the *conducting* power of some solid, as bone or muscle in proximity, or by the *conveying* power of the blood currents that aid in their production. The latter may be either the direct, normal, current or the indirect, regurgitant, current.

There are four principal points on the chest at which the sounds, normal and abnormal, made at the four different valves may be best heard and studied.

Sounds made at the pulmonic valve should be studied at the 2d left intercostal space ("Pulmonic Interspace") close to the sternum.

Sounds made at the aortic valve should be studied at the 2d right intercostal space ("Aortic Interspace") close to the sternum.

Sounds made at the mitral valve should be studied at the apex of the heart.

Sounds made at the tricuspid valve should be studied over the ensiform cartilage.

There are, however, some exceptions to these four general rules: e. g., in the case of mitral obstruction the sounds are best studied at the 4th left costo-chondral articulation, and in the case of aortic regurgitation the sound should be studied at the junction of the 3d left intercostal space with the sternum.

Areas of Transmission.

The different valvular sounds can also generally be heard at one or more points besides the point of maximum intensity.

At these points the intensity of the sound is nearly or quite equal to that of the maximum point.

These points of secondary intensity differ for the different valvular sounds and are called the *Areas of Transmission*, because the sound is transmitted there

either by some solid or by a blood current, exactly as in the case of the maximum point.

Time of Occurrence.

Each heart sound, normal and abnormal, occurs either during systole or diastole of the heart. The abnormal sounds also generally stand in some relation (as to time) to the normal sounds, i. e., they occur either before, during, or after, the first or second sound, or they may take the place of one of them altogether, so that the normal sound, with which it is in relation, will not be heard at all. By a close study of these relations we ascertain the *Time of Occurrence* of the murmur.

Changes in the Heart.

(Enlargement of the Heart.)

Valvular lesions generally produce some enlargement of the heart, such as dilatation, hypertrophy, or dilated hypertrophy, each lesion producing an enlargement peculiar to itself, and they are generally accompanied by permanent murmurs. Thus aortic valvular lesions produce enlargement of the left ventricle, mitral lesions produce enlargement of the left auricle, right ventricle, and left ventricle, &c.,—the enlargement being ascertained by inspection, palpation, and percussion.

Some think dilatation occurs first and others hypertrophy ; but the two usually occur together untilhypertrophy ceases and uncompensated dilatation remains (Page).

Other Symptoms.

Valvular lesions likewise produce other symptoms and physical signs such as, cyanosis, dyspnoea, jugular pulsation, pulmonary congestion, pulmonary oedema, dropsy beginning in the feet, thrill, cough, hemorrhages, vertigo, &c.

Effect on the Pulse.

The pulse may or may not be affected by organic valvular lesions. Aortic Regurgitation is the only cardiac lesion accompanied by a *characteristic* pulse.

Effect on the Rhythm of the Heart.

The rhythm of the heart may or may not be affected by organic valvular lesions. There is no cardiac lesion accompanied by a characteristic rhythm.

With a thorough knowledge of the anatomy and physiology of the heart and of the three laws above given the following nine rules will assist in the detection and diagnosis of valvular murmurs :

Rule I. Determine by ausculation at the four points above given whether an abnormal sound is present or not.
(Is an abnormal sound present ?) If present,

Rule II. Determine the quality of the sound.
(What is its quality ?).

Rule III. Determine the point of maximum intensity of the sound.
(Where is it heard the loudest ?).

Rule IV. Determine the areas of transmission of the sound.
(Where else is it heard ?).

Rule V. Determine the time of occurrence of the sound.
(When does it occur ?).

Rule VI. Determine what changes have occurred in the heart.
(What part of the heart is enlarged ?).

Rule VII. Determine the other symptoms present.
(What other symptoms are present ?).

Rule VIII. Determine the effect of the lesion on the radial pulse.

(What is the effect on the pulse?).

Rule IX. Determine the effect of the lesion on the heart's rhythm.

(What is the effect on the rhythm?).

The foregoing laws and rules can also be applied with some modification to the study and diagnosis of non-valvular murmurs, both organic and inorganic.

As before stated endocarditis, which is the most frequent cause of organic heart lesions. attacks the right heart before birth and the left heart after birth. That is, it is more apt to attack that side of the heart which has the most work to do. Hence organic murmurs connected with the left side of the heart are very frequent, while those connected with the right side are very infrequent.

Porter of New York says that "during twelve years of observation in which one thousand autopsies were held, only one valvular lesion of the right heart was found, and that was a pulmonary incompetency due to congenital perforation of the pulmonary valve, which had never been recognized during life."

On the left side of the heart mitral murmurs are more frequent before middle life and aortic murmurs after that period.

SPECIAL VALVULAR MURMURS.

These are eight in number and are as follows :—

MITRAL OBSTRUCTIVE MURMUR.

Other names :

Mitral presystolic, direct, constrictive, stenotic, murmur.

Causes :

Some obstruction at the mitral valve, due to :

Granulation, vegetation, calcareous deposit, on the valve segments ;

Thickening or contraction of the valve segments ;

Adhesion of the segments to each other ;

Contraction of the chordae tendineae ;

Narrowing or constriction of the orifice.

Quality :

Blowing, blubbering, sometimes musical.

Point of maximum intensity :

Fourth left costo-chondral articulation, as the sound is transmitted (conveyed) by the normal, direct, current from the mitral valve which is deep seated to that point where it becomes superficial (Porter).

Apex of the heart, as the sound is transmitted (conducted) by the thick, solid, wall of the left ventricle from the deep seated valve to the superficial apex (Page). This murmur is not very loud and may appear and disappear ; all others are permanent.

Areas of transmission :

This murmur is not generally transmitted, as it is not generally loud enough on account of weakness of the left auricle (Porter).

(1) *Fourth left intercostal space* just above the apex (Page);

(2) *All over the chest*, if loud enough. (Page).

Time of occurrence :

Presystolic, it precedes the first sound, because it occurs while the blood is passing through the mitral orifice and before the contraction of the ventricles. (Sh-ub tâ).

(It is really diastolic, but as it occurs during the last part of diastole and just before systole it is called presystolic).

Changes in the Heart :

(1) Enlargement of the left auricle, because it has more work to do in order to force the blood past the obstruction.

(2) Enlargement of the right ventricle, because it has more work to do in order to drive the blood through the lungs in which it has accumulated on account of the obstruction at the mitral orifice.

(3) Atrophy of the left ventricle owing to the small amount of blood entering it.

Other Symptoms accompanying the murmur :

Cough, cyanosis, dyspnoea, cardiac asthma, haemoptysis, hemiplegia, aphasia ;

Jugular pulsation on the right and then on the left ;

Pulmonary congestion, pulmonary oedema, hemorrhagic infraction of the lung ;

Dropsy beginning in the feet, ascites ;

Cardiac region more prominent than normal ;

Cardiac impulse more forcible than normal ;

Presystolic thrill felt over 4th or 5th left interspace, due to hypertrophy of the left auricle. (This is said to be pathognomonic) :

Apex beat within the left mamillary line :

Left auricular impulse in the 3d left interspace, owing to enlargement of the left auricle.

Right ventricular impulse *may* occur at the end of the ensiform cartilage. but it does not usually do so.

Area of dullness is increased towards the right, sometimes to the left (but not as much as in mitral regurgitation as the left ventricle is not enlarged).

Second sound accentuated over pulmonic interspace because of hypertrophy of right ventricle, and diminished (weakened) over aortic interspace because of atrophy of left ventricle.

Second sound reduplicated at the base because the pulmonic valves close both more quickly and more forcibly than the aortic on account of the hypertrophy of the right ventricle.

Effect of the lesion on the pulse:

Generally none; but the pulse *may* be small, weak, and irregular, owing to the small amount of blood thrown into the arteries by the atrophied left ventricle.

Effect of the lesion on the rhythm:

None.

Note: Mitral obstruction may be congenital, idiopathic, or due to endocarditis. It chiefly affects women and children and is one of the severest forms of heart disease. Compensation may occur.

MITRAL REGURGITANT MURMUR.

Other names:

Mitral systolic, indirect, insufficient, reflux murmur.

Cause:

A leakage at or insufficiency of the mitral valve due to:—

Granulation, vegetation, calcareous deposit, on the valve segments:

Thickening or contraction of the valve segments:

Adhesion of the valve segments to each other or to the walls of the ventricles:

Contraction of the chordae tendineae:

Dilated hypertrophy of the left ventricle causing enlargement of the orifice which thus allows a leak.

Quality :

Blowing—sometimes musical.

Point of Maximum Intensity :

The apex as the sound is transmitted (conducted) by the solid wall of the left ventricle from the mitral valve which is deep seated to the apex where it becomes superficial.

Areas of Transmission :

(1) *Behind* just between the 8th dorsal vertebra and inferior angle of the left scapula, as the sound is transmitted (conveyed) there by the regurgitant current (exceptions).

(2) *Along the left lateral base of the chest* (subaxillary region) as the sound is transmitted (conducted) there by the ribs from the apex (exception).

(3) *Over the left auricle*, as the sound is transmitted (conducted) there by the thick, solid wall of the left auricle.

(4) *All over the chest.* (Page).

Time of Occurrence :

Systolic, it occurs with, and if loud enough may take the place of, the first sound, because it is produced by the regurgitant current at the very time at which the first sound is also being produced (U-sh tâ).

Changes in the Heart :

(1) Enlargement of the left auricle, because it has more work to do in order to rid itself of the increased amount of blood.

(2) Enlargement of the right ventricle, because it has more work to do in order to drive the blood through the lungs in which it has accumulated on account of the leak at the mitral orifice.

(3) Enlargement of the left ventricle, because it has more work to do in order to rid itself of the increased amount of blood driven into it by the enlarged left auricle. (Vierordt).

Other Symptoms Accompanying the Murmur :—

Cough, cyanosis, dyspnoea, cardiac asthma, haemoptysis, palpitation, clubbed fingers especially in children if the disease is of long standing.

Jugular pulsation on the right side due to tricuspid insufficiency.

Pulmonary congestion, pulmonary oedema, hemorrhagic infraction of the lung, bronchitis, congestion of the liver, spleen, and kidneys :

Dropsy beginning in the feet :

Cardiac region more prominent than normal :

Cardiac impulse more forcible than normal :

Urine scanty, and contains albumen and casts :

Systolic purring thrill felt over the 4th left intercostal space and apex, and tremor of the chest wall.

Apex beat visible and displaced downward and to the left outside the mammillary line, owing to hypertrophy of left ventricle.

Left auricular impulse in the 2d left interspace due to enlargement of the left auricle, either systolic or diastolic.

Right ventricular impulse near ensiform cartilage due to enlargement of the right ventricle.

Epigastric pulsation due to enlargement of the right ventricle.

Area of dullness is increased to the right, to the left, and upward.

Second sound accentuated over both pulmonic and aortic interspaces, because of hypertrophy of right and left ventricles ; but more so over pulmonic interspace owing to regurgitation at the mitral orifice.

This murmur may be present in the recumbent posture and absent in the erect posture.

Effect of the lesion on the pulse :

Generally none ; but the pulse *may* be compressible, irregular, intermittent, sometimes large and sometimes small ; but it is generally regular.

Effect of the lesion on the rhythm :

Generally none ; but the heart *may* intermit. Irregular rhythm is not peculiar to any valvular lesion.

Note : Mitral regurgitation is the most frequent of all valvular lesions of the heart. It is generally primary, but may be secondary to aortic obstruction or regurgitation and is usually due to endocarditis. Compensation may occur.

AORTIC OBSTRUCTIVE MURMUR.

Other names :

Aortic systolic, direct, constrictive, stenotic, murmur.

Cause :

Some obstruction at the aortic valve due to :—

Granulation, vegetation, calcareous deposit, on the valve segments ;

Thickening of the valve segments ;

Adhesion of the valve segments to each other ;

Narrowing or constriction of the orifice.

Quality :

Blowing—sometimes musical.

Point of maximum intensity :

Aortic Interspace (Page & Porter), because the sound is transmitted (conveyed) by the normal, direct. current, from the aortic valve which is deep-seated (behind the left edge of the sternum) to the aortic interspace where it becomes superficial.

It is rendered more distinct by walking rapidly.

Areas of transmission :

(1) *Arteries of the neck* (carotid and subclavian), because it is transmitted (conveyed) there by the normal, direct current.

(2) *Behind* just to left of the 4th and 5th dorsal vertebrae, because it is transmitted (conveyed) there by the normal current.

(3) *All along the sternum* (by conduction), if loud enough.

(4) *All over the chest*, if loud enough.

(5) *Pulmonary Interspace*, because the pulmonary artery takes up the sound from its proximity to the aorta.

Time of occurrence :

Systolic, it occurs with the first sound or just before the second sound. (Up sh-tâ).

Changes in the heart :

Enlargement of the left ventricle, because it has more work to do in order to force the blood past the obstruction at the aortic orifice.

Other symptoms accompanying the murmur :

Cough, dyspnoea, palpitation, cheyne-stokes breathing, vertigo, fainting, rusty sputa, cardiac pain :

Pulmonary congestion :

Dropsy in the lower part of the body :

Cardiac impulse more forcible than normal :

Basic systolic thrill when dilated hypertrophy is marked :

Apex beat displaced downward and outward owing to enlargemt of the left ventricle :

Area of dullness is increased to the left :

Second sound is normal over pulmonic interspace and diminished (weak) over aortic interspace, owing to the obstruction and hence diminished amount of blood in the aorta.

Effect of the lesion on the pulse :

Generally none ; but the pulse may be small, hard, and rigid.

Effect of the lesion on the rhythm : None.

Note : Aortic obstruction is the least harmful of all valvular lesions of the heart and is generally due to endocarditis. Compensation may occur.

AORTIC REGURGITANT MURMUR.

Other names :

Aortic diastolic, indirect, insufficient, reflux, murmur.

Cause :

A leakage at or insufficiency of the aortic valve due to :—

Granulation, vegetation, calcareous deposit, on the valve segments :

Thickening or contraction of the valve segments :

Adhesion of the valve segments to the walls of the vessel.

Tears, perforations, or rupture, of the valve segments.

Quality :

Blowing—sometimes musical ; it is harsher and higher pitched than the aortic obstructive murmur. The two combined form the "Steam-tug murmur" (hoo-chee).

Point of Maximum Intensity :

(1) *Junction of the 3d left intercostal space* with the sternum (Porter), because it is transmitted (conveyed) by the indirect, regurgitant, current from the aortic valve which is deep seated (behind the left edge of the sternum) to the 3d left interspace where it is superficial.

(2) *Over the sternum* about the 4th costal cartilage, as it is transmitted (conducted) there by the solid sternum (Page).

Areas of Transmission :

(1) *Apex*, because it is conveyed there by the regurgitant current (Page and Porter).

(2) *Ensiform cartilage*, as it is conducted there by the solid sternum (Page and Porter).

(3) *Aortic interspace* (Page).

(4) *All along the sternum* by conduction (Page).

(5) *Behind* along the spinal column (Page).

(6) Sometimes it is so loud it may be heard all over the room and may prevent sleep (Page & Da Costa).

Time of occurrence :

Diastolic, it occurs with and if loud enough takes the place of the 2d sound (Page), because it is produced by the regurgitant current at the very time at which the 2d sound is also being produced (Up t-sh).

Changes in the heart :

Enlargement of the left ventricle, because it has more work to do in order to rid itself of the increased amount of blood which it receives by the leak.

Other symptoms accompanying the murmur :

Cough, dyspnoea, headache, vertigo, faintness, palpitation, cardiac pain, anaemia, fever, embolism, haemoptysis, cerebral apoplexy, pallor of the nails during diastole :

Pulmonary congestion. pulmonary oedema ;

Dropsy :

Cardiac region more prominent than normal:

Arterial pulsation visible all over the body, wherever the arteries come near the surface :

Cardiac impulse more forcible than normal and heaving :

Basic diastolic thrill and tremor of the cardiac region :

Apex beat is heaving and displaced downward and

outward outside the mammillary line owing to the enlargement of the left ventricle.

Area of dullness increased downward and to the left and greater than in any other cardiac lesion :

Arterial Murmur, sometimes double, in the carotid, subclavian, and femoral arteries :

Effect of the lesion on the pulse :

Radial pulse starts with a thump, but is unsustained and collapses under the finger, because the left ventricle is very much hypertrophied and the aorta empties itself in two directions at once. It is called collapsing, unsustained, vanishing, locomotive, "water hammer," pulse. (This is the only cardiac lesion that is accompanied by a characteristic pulse.)

Effect of the lesion on rhythm :

Note. Aortic regurgitation is the most hopeless and fatal of all valvular lesions of the heart, with possibly the exception of tricuspd regurgitation (Page).

It is due to congenital malformation (particularly fusion of two segments), endocarditis (less common), sclerosis of the segments (most common), and strain (as in athlete's heart).

This lesion causes the largest hearts and sudden death more frequently than any other lesion. Compensation may occur.

TRICUSPID OBSTRUCTIVE MURMUR.

Other Names :

Tricuspid presystolic, direct, constrictive, stenotic, murmur.

Cause :

Some obstruction at the tricuspid valve due to:—

Granulations, vegetations, calcareous deposits on, or thickening of, valve segments, narrowing or constriction of the orifices, &c.

Quality :

Point of Maximum Intensity :

Ensiform cartilage.

Areas of transmission :

Not transmitted—too feeble.

Time of Occurrence :

Presystolic, it precedes the first sound (Sh-ub tâ).

Changes in the Heart :

Enlargement of the right auricle theoretically may occur ; but no particular change in the form and size of the heart is known.

Other symptoms accompanying the murmur :

Cyanosis, dropsy :

Presystolic Thrill :

Area of dullness increased, especially to the right of the sternum (Osler).

Effect of the lesion on the pulse : None.

Effect of the lesion on the rhythm : None.

Note : Tricuspid obstruction is very rare, and when it is present no murmur is usually heard. This is due to the feebleness of the venous current and to the weakness of the right auricle. It is generally congenital, but may be acquired, and is more frequent in women. It is never found alone, but is always combined with mitral obstruction and is practically always secondary to mitral lesions. The prognosis is unfavorable. It is usually only on postmortem examination that tricuspid obstruction is found to have existed. Long continued compensation is scarcely conceivable.

TRICUSPID REGURGITANT MURMUR.

Other names :

Tricuspid systolic, indirect, insufficient, reflux, murmur.

Cause :

Leakage at or insufficiency of the tricuspid valve. This may be due to—

(1) Granulations, vegetations, calcareous deposits on, or thickening of valve segments, caused by foetal endocarditis, or

(2) Separation of the valve segments caused by enlargement of the right ventricle. This enlargement may be due to some disease of the lung causing obstruction of the circulation through it, as cirrhosis, emphysema, chronic bronchitis, or it may be secondary to mitral obstruction or regurgitation.

Quality :

Blowing and very feeble.

Point of Maximum Intensity :

Ensiform cartilage, because it is transmitted (conducted) there by the solid sternum.

Areas of Transmission :

Not transmitted—too feeble (Page).

Right axilla if loud enough, because it is transmitted (conveyed) there by the regurgitant current which follows the right auriculo-ventricular axis (Osler).

Sternal end of the 5th right rib (Strümpell).

Time of occurrence :

Systolic, it occurs with the first sound (U-sh tâ).

Changes in the heart :

Enlargement of the right ventricle, because it has more work to do in order to drive forward an impeded pulmonary circulation due either to mitral lesion, cirrhosis, emphysema, bronchitis, &c.

Other Symptoms accompanying the murmur :

Cyanosis, dropsy, pulmonary congestion, pulmonary oedema ;

Jugular pulsation (more forcible on the right side than the left side.) (Jugular venous pulse).

Cardiac impulse, forcible in lower sternal region.

Systolic distention of the liver due to transmission of the wave down the vena cava to the hepatic veins and then to the liver.

Area of dullness increased to the right of the sternum.

Effect of the lesion on the pulse: None.

Effect of the lesion on the rhythm: Generally none, but sometimes irregular.

Note. Tricuspid regurgitation is sometimes primary and is then due to foetal endocarditis.

It is generally secondary to mitral obstruction or regurgitation, and is then due to enlargement of the right ventricle which causes separation of the valves.

PULMONIC OBSTRUCTIVE MURMUR.

Other names:

Pulmonary systolic, direct, constrictive, stenotic, murmur.

Cause:

Some obstruction at the pulmonary valve due to:—

Granulations, vegetations, calcareous deposits on, thickening and adhesions of, the valve segments, narrowing of the orifice, &c.

Quality:

Blowing.

Point of Maximum Intensity:

Pulmonary Interspace.

Areas of transmission:

Both lungs, because it is transmitted (conveyed) there by the normal direct current;

Behind over both sides of the back for the same reason;

All along the sternum by conduction;

All over the chest if loud enough;

Out towards the left shoulder.

Time of occurrence :

Systolic, it occurs with the first sound or just before the second sound (Up sh-tâ).

Changes in the heart :

Enlargement of the right ventricle, because it has more work to do in order to drive the blood past the obstruction.

Other Symptoms accompanying the murmur :

Cyanosis with coolness of the skin ;
Eyes prominent because of oedema ;
Club-like thickening of the terminal phalanges ;
Claw-like curvature of the nails ;
Vertigo and faintness, dyspnoea, dropsy ;
Gums spongy and bleeding ;
Cardiac region prominent ;
Basic systolic thrill in pulmonic interspace ;
Area of dullness increased, especially towards the right.
Second sound in pulmonic interspace is weak or absent or replaced by the murmur.

Effect of the lesion on the pulse : None.

Effect of the lesion on the rhythm :

Note : Pulmonary obstruction is most frequent in children, who are born with it and die early. It is therefore generally congenital, and is then due to foetal endocarditis or to anomalies in the development of the heart. It is the most frequent of the congenital forms of heart disease. It may, however, be acquired and may occur in adult life. The narrowing may be either at the orifice, in the conus arteriosus, or in the pulmony artery. There may be patency of the fossa ovalis, of the ductus arteriosus, and defects in the ventricular septum.
Compensation may occur.

PULMONARY REGURGITANT MURMUR.

Other names :

Pulmonary diastolic, indirect, insufficient, reflux, murmur.

Cause :

Leakage at or insufficiency of the pulmonary valve due to :—

Granulation, vegetation, calcareous deposit on, or thickening of, valve segments, &c.

Quality :

Blowing.

Point of maximum intensity :

Pulmonary interspace (Page).

Over the pulmonary valve (Strüpmell).

Areas of transmission :

Down the sternum.

Time of occurrence :

Diastolic, it occurs with or takes the place of the second sound (Up t-sh).

Changes in the heart :

Enlargement of the right ventricle, because it has more work to do in order to rid itself of the increased amount of blood which it receives by the leak.

Other symptoms accompanying the murmur :

Cyanosis, dropsy :

Jugular pulsation :

Diastolic thrill :

Area of dullness increased especially towards the right.

Effect of the lesion on the pulse. None.

Effect of the lesion on the rhythm :

Note. Pulmonary regurgitation is so rare that it is hardly worth mentioning, is of little practical significance, and may be thrown out. It is more of a clinical curiosity than of any practical value.

It is congenital, and may then be due to malformation, or it may be acquired after birth.

The valve segments may be congenitally fused, or they may be glued to the walls of the pulmonary artery. There may be patency of the fossa ovalis. Compensation may occur.

During twelve years in which one thousand autopsies were held Porter found only one lesion of valves on the right side of the heart, and that was pulmonary incompetency due to congenital perforation of the valve segments, and was not diagnosed during life. The pulmonary valves are the most rarely affected of all the valves.

INTRAVENTRICULAR MURMUR.

Other names:

Systolic, mitral, apex, basic, murmur.

Cause:

Organic lesions within the ventricles, such as:
Roughening of the ventricular endocardium:
Vegetations on the walls of the ventricles:
Misattachment of a chorda tendinea:
Thickening and roughening of a chorda tendinea:
Twisting of columnae carneae:
Fibrinous shreds across the blood current:
Cardiac ventricular aneurism.

Quality:

Blowing and very feeble.

Point of Maximum Intensity:

Apex or base (aortic interspace).

Areas of Transmission:

Not transmitted.

Time of Occurrence:

Systolic.

Change in the Heart :

None, except in case of cardiac ventricular aneurism which causes enlargement of the ventricle.

Other symptoms accompanying the murmur :

Effect of the lesion on the pulse and rhythm : None.

Prognosis : Favorable.

INTRAARTERIAL MURMUR.

Other names :

Systolic, basic.

Cause :

Organic lesion of the inside of the aorta, such as :—

Roughening of lining of ascending aorta :

Vegetations on lining of ascending aorta :

Coarctation (bending together) of the aorta ;

Constriction, sacculation, pouching, of the aorta near the heart :

Pressure by tumor or pericardial fluid on origin of aorta.

Quality ;

Point of Maximum Intensity :

Seat of their production.

Areas of Transmission :

Not transmitted.

Time of Occurrence :

Systolic :

Changes in the Heart :

None, usually.

Other symptoms accompanying the murmur :

Effect of the lesion on pulse and rhythm : None.

Note. This lesion is caused by endocardtis and may be in the pulmonary artery also. In that case the murmur would be caught up by the aorta.

INORGANIC (FUNCTIONAL) HEART MURMURS.

These are adventitious sounds heard in connection with the heart, during the performance of its function, without the presence of any organic lesion of the heart.
Varieties : These are
(1) Dynamic, and (2) Cardio-respiratory.

DYNAMIC MURMURS.

These are adventitious sounds heard in connection with the heart during the performance of its function, and are due to perverted action caused by anaemia, neuroses, violent exercise, pressure on the chest wall, &c.
Other names :
Systolic, mitral, apex, aortic, basic.
Cause :
Perverted action of the blood in the heart or of the heart muscle caused by anaemia, neuroses, violent exercise, pressure, &c.
Quality :
Blowing and soft.
Point of maximum intensity :
Base generally and *apex* rarely.
Areas of Transmission :
Not transmitted as far as organic murmurs.
Time of Occurrence :
Systolic.
Changes in the heart :
Enlargement may or may not occur.
Other symptoms accompanying the murmurs :
Anaemia, venous hum (see venous hum), &c.
Effect of the trouble on pulse and rhythm : None.

CARDIO-RESPIRATORY MURMUR.

This is a sound or murmur caused by the impulse of the heart forcing air out of some air vesicles, or a bronchial tube, or a pulmonary cavity, near by.

It is heard at the end of a full inspiration and ceases when the patient holds the breath after an expiration.

VENOUS HUM.

(Bruit de Diable.)

This is a continuous, remittent, roaring sound, heard over certain large veins, as the jugular, subclavian and femoral veins, usually in an anaemic person.

It is heard best over the junction of the internal jugular and subclavian veins, and ceases when pressure is made on the vein on the distal side of the stethoscope, and returns when the pressure is removed.

In listening for venous hum, turn the patient's head to the opposite side and elevate the chest so as to make the tissues tense.

Cause :—The cause of venous hum is not well understood and various theories have been advanced, as follows:

(1) Watery, venous, blood, especially in anaemia, is said to be sonoriferous, while arterial blood is not (Walshe). This is probably the true cause.

(2) Vibration of the valves of the veins has been advanced, but is not generally accepted.

(3) Vortiginous (eddying, whirling) movement of blood in the ampullae at the junction of the internal jugular and subclavian veins, in anaemia. The volume of blood in anaemia is smaller while the ampullae remain the same size, as they are adherent to the surrounding tissue. This allows space in the ampullae for the vortiginous movement, especially on the left side of the neck where the blood has to take a curved or more tortuous course (Guttman).

Criticism of Guttman by Page.

(1) Venous hum is produced best when the blood has

a straight and rapid course, as on the right side of the neck.

(2) It is not probable that the ampullae would be kept from contracting and becoming accommodated to the diminished volume of blood, as the surrounding tissue is so loose.

PURRING THRILL.

This is a peculiar sensation felt by placing the palm of the hand lightly over the lower pericardium in certain forms of heart disease. It is usually felt in the 4th left intercostal space on or near the mammillary line, but also at the base of the heart.

It depends for its production upon three abnormal factors :

(1) Increased capacity of the heart (i. e., dilatation).

(2) Increased propelling force (i. e., hypertrophy).

(3) An abnormal orifice (i. e., a leak or a stenosis).

The presence of any two of these will not produce it.

Page thinks though it may be due also to a ribbon-like vegetation with one end free and vibrating in the current of blood.

It is not constant, and its disappearance is unfavorable, as it indicates that hypertrophy has ceased to compensate.

Diseases :

Mitral obstruction (presystolic thrill over 4th or 5th left interspace) ;

Mitral regurgitation (systolic purring thrill over 4th left interspace and apex) ;

Aortic obstruction (basic systolic thrill) ;

Aortic regurgitation (basic diastolic thrill) ;

Tricuspid obstruction (presystolic thrill) ;

Tricuspid regurgitation (no thrill) ;

Pulmonary obstruction (basic systolic thrill in pulmonic interspace);

Pulmonary regurgitation (diastolic thrill).

ANEURISMAL BRUIT.

This is the sound heard over an aneurism and is caused by the passage of blood from a narrow vessel into a dilated sac and out again.

It is systolic in time and the pitch is high when the aneurism has a small mouth and low when the mouth is large. It is most distinct when the sac-mouth is large, and scarcely perceptible or absent when the sac-mouth is small or the sac is nearly filled with coagulum.

Thoracic and abdominal aneurisms are most distinct in front.

Femoral and popliteal aneurisms are made more distinct by elevating the limb while the patient is recumbent.

The bruit is louder than heart sounds, is accompanied by a peculiar thrill, and eccentric or expansile pulsation, is synchronous with the aneurismal pulsation, and ceases if the artery is compressed above. It may sometimes be heard while the ear is several inches from the skin surface.

Quality: The quality is blowing and low pitched, or filing, hissing, purring, rasping, roaring, sawing, whirring, whistling, whizzing, and high pitched.

It sometimes sounds like the buzzing of a fly in a bottle or it may be a hollow sound.

Besides the systolic sound described above there is a diastolic murmur which is softer and causes the to-and-fro-sound.

The disease in which aneurismal bruit is heard is aneurism.

AUSCULTATORY PERCUSSION.

This is the act of listening, while the stethoscope is applied to the part, to the sound elicited by percussion.

It is used chiefly in mapping out solid organs or in ascertaining their boundaries and is a very delicate method of examination.

It may be applied to any part of the body, but is chiefly limited to the chest and abdomen.

The diseases in which it is employed are enlargements of the heart, liver, spleen, kidneys, tumors, solidification of the lungs, &c.

It is better that one person should percuss while another auscultates with the stethoscope.

SYMPTOMS OF SPECIAL ORGANS.

SYMPTOMS

POINTING TO THE BRAIN AND SPINAL CORD.

I. Deranged Intellection.
   Delirium—Stupor—Coma—Insomnia.

II. Deranged Sensation :
   Hyperaesthesia — Anaesthesia — Headache — Vertigo.

III. Deranged Vision.

IV. Deranged Hearing.

V. Deranged Reflexes.
   Increased—Diminished.

VI. Deranged Motion :
   (1) Paralysis.
   Hemiplegia—Monoplegia—Paraplegia.
   (2) Ataxia.
   (3) Tremor.
   (4) Spasms and convulsions.

VII. Deranged nutrition and secretion.

SYMPTOMS

POINTING TO THE LARYNX.

I. Altered Voice (voice changes):
   Hoarseness—Loss of Voice.
II. Dyspnoea:
   Breathing coarse, labored, noisy, paroxysmal, shrill (laryngeal stridor.)
III. Cough:
   Harsh, ringing, paroxysmal, nocturnal.
IV. Pain:
   Local, tickling, burning, increased by deglutition.

SYMPTOMS

POINTING TO THE LUNGS.

I. Cough:
   Dry and moist, laryngeal, tracheal, bronchial, sympathetic.
II. Dyspnoea.
III. Sputa:
   Mucus (white).
   Mucopus (yellowish or yellowish green).
   Pus (greenish or greenish yellow).
   Tinged by bile, pigment, or blood.
   Sputum consists of, water, albumin, mucin, epithelium, pus corpuscles, blood corpuscles, crystals, fibrinous coagula, fungous growths, elastic fibres, bacteria, &c.
IV. Haemoptysis.
V. Physical Signs. (Described in the foregoing).

SYMPTOMS

POINTING TO THE HEART.

I. Pain in the cardiac region (Angina pectoris).
II. Cough.

III. Palpitation.
IV. Dyspnoea.
V. Hemorrhages any where.
VI. Dropsy anywhere (beginning first in the feet):
VII. Disorders of the brain and nervous system.
VIII. Engorgement of the viscera.
IX. Derangement of the circulation.
X. Aspect of the face.
XI. Physical signs (described in the foregoing).

SYMPTOMS

POINTING TO THE PLEURA.

I. Pain in the side :
Sharp ; lancinating ; severe ; increased by cough, full inspiration, and pressure.
II. Cough.
III. Dyspnoea.
IV. Physical signs (described in the foregoing).

SYMPTOMS

POINTING TO THE DIAPHRAGM.

Hiccough (Singultus), pain, spasm, paralysis.

SYMPTOMS

POINTING TO THE STOMACH.

I. Loss of appetite :
Appetite may be capricious, even ravenous, in gastric ulcer, gastric neuralgia, &c.
II. Excessive acidity of the stomach :
Causes : (1) Gastric juice may be in great quantities or may have abnormal amount of acid ;
(2) Decomposition of food most frequent cause.
The acids in the stomach are, hydrochloric, lactic, acetic, carbonic, butyric, and oxalic.

III. Flatulence (=accumulation of gas in the stomach or intestines).

Causes: (1) Air which has been swallowed.

(2) Imperfectly digested food, predisposing to fermentation.

(3) Secretion from the blood vessels.

Eructation is the expulsion of gas from the stomach through the mouth.

"Rotten egg" taste and odor are due to sulphuretted hydrogen.

Odorless eructation due to hydrogen, nitrogen, carbonic acid.

Flatulence may be due to thoracic aneurism or gastric neurosis which predispose to fermentation.

IV. Pain:

Increased or not by pressure; increased or relieved by food, &c.

V. Physical signs.

VI. Nausea and vomiting.

Causes: (1) Irritation of cerebral centres of nerves supplying the vomiting organs, stomach, diaphragm, oesophagus.

(2) Irritation of peripheral extremities of nerves supplying the vomiting organs, the stomach, diaphragm, and oesophagus.

(3) Mechanical obstruction of the stomach or intestines.

(4) Sympathy, as in disease or injury of some distant organ, pregnancy, &c.

CHARACTERISTIC VOMIT.

Food or liquid vomit mixed with saliva and mucus occurs in irritability of the stomach or when there is an obstruction to the entrance to the stomach.

Sarcinae and yeast fungi vomit occurs as the result of fermentation in the stomach.

Thin watery vomit, with burning sensation ("water brash" or pyrosis) occurs in :—

(1) Functional derangement of the stomach, due to coarse food ;
(2) Organic disease of the stomach ;
(3) Pregnancy, &c.

Mucus vomit occurs in gastritis and gastric catarrh.

Bile vomit occurs when the act of vomiting is frequent or protracted as in acute gastritis or the beginning of some acute malady.

Pus vomit, when pus is in small amount, occurs in gastric ulcer or cancer ; when pus is in large amount it is due to rupture of abscess into the stomach.

Pure blood vomit occurs in ulcer of the stomach, injury of the stomach, scurvy, typhus fever, yellow fever, disease of the heart, liver, spleen, &c., vicarious hemorrhage.

Coffee ground vomit, with cancer cells, occurs in cancer of the stomach, and without cancer cells whenever the hemorrhage into the stomach is in small amount and the blood remains for some time in the organ.

The coffee ground-like material is nothing but blood that has undergone change from remaining long in the stomach.

Coffee ground ("Black") vomit occurs in yellow fever, the 3d stage. (See above).

Rice water vomit occurs in Asiatic cholera, the 2d stage. It consists chiefly of serum from the blood.

Stercoraceous (fecal) vomit occurs in obstruction of the bowels, strangulated hernia, typhoid conditions, peritonitis, &c.

SYMPTOMS

POINTING TO THE INTESTINES AND PERITONEUM.

Pain.
Diarrhoea.
Constipation.
Headache.
Impaired Digestion.
Nausea and Vomiting.
Tympanites.

SYMPTOMS

POINTING TO THE LIVER.

I. Pain. This occurs, over the liver, in the upper portion of the thorax, in the scapula, shoulder and umbilicus. It may be pericardial and increased by pressure.
II. Digestive troubles.
III. Disturbance of the portal circulation; e. g., dropsy, piles, hemorrhages from stomach and intestines, enlargement of spleen and superficial and abdominal veins, partial peritoneal inflammation.
IV. Jaundice.
V. Ascites.
VI. Clay colored stools.
VII. Fatty stools.
VIII. Bile in the urine.
IX. Nodules on the liver.
X. Enlargement of the liver.
XI. Atrophy of the liver.

SYMPTOMS

POINTING TO THE KIDNEYS.

Pain and tenderness in lumbar region :
Headache :
Suppression of urine :
Polyuria :
Convulsions :
Coma :
Dropsy :
Asthma :
Gastro-intestinal disorders :
Abnormal condition of the urine:
Enlargement.

SYMPTOMS

POINTING TO THE SPLEEN.

Pain and tenderness over the region increased by pressure, cough, and full inspiration.

Pyrexia—Dry cough—Delirium—Sense of suffocation—Enlargement of the spleen.

SYMPTOMS

POINTING TO THE PANCREAS.

Pain over the organ :
Nausea and vomiting :

Anxiety, restlessness, pyrexia, tympanites, delirium, jaundice, increased aortic pulsation over the organ, clay colored stools, fatty stools, enlargement of the pancreas.

SYMPTOMS

POINTING TO THE UTERUS AND OVARIES.

Pelvic and lumbar pain, headache, vertigo, bearing down pain, hemorrhage, leucorrhoea, enlargement of the uterus and ovaries.

SYMPTOMS

POINTING TO THE BLADDER.

Pain and tenderness, hemorrhage, frequent micturition—Dysuria—Ischuria—Distention.

SYMPTOMS

POINTING TO THE PROSTATE.

Pain, tenderness, heat, sense of fullness and throbbing, enlargement, retention of urine.

MISCELLANEOUS SYMPTOMS.

JAUNDICE.

This occurs:

(1) In gastro-duodenal catarrh, (the rule and early by obstruction of the common bile duct).

(2) In liver troubles, such as:

Catarrh of the bile ducts (always);

Passive congestion of the liver (slight but often);

Suppurative hepatitis (abscess), (only when bile ducts are obstructed);

Acute yellow atrophy of the liver, (the rule);

Cirrhosis of the liver (late and slight; if well marked it is due to some complication).

Biliary and hypertrophic cirrhosis of the liver (the rule and early);

Syphilis of the liver (only if bile ducts are obstructed);

Cancer of the liver, (only if bile ducts are obstructed);

Echinococcus (hydatids) of the liver (only if bile ducts are obstructed);

Suppurative pylephlebitis (only if bile ducts are obstructed);

Pernicious jaundice (always);

Icterus neonatorum (always);

Cholelithiasis (only if hepatic duct or common bile duct is obstructed by stone or catarrh);
"Menstrual Jaundice," which occurs when menses are scanty or absent, is due to vicarious hyphæmia of the liver ;

(3) In cancer of the pancreas (only if bile ducts are obstructed).

ASCITES.

This occurs :—

(1) In liver troubles, such as :—
Biliary and Hypertrophic cirrhosis (always late, generally slight, sometimes enormous, sometimes absent);
Cirrhosis (the rule and enormous);
Suppurative hepatitis (abscess) (rare and only if portal circulation is obstructed);
Syphilis of liver (sometimes and only if portal circulation is obstructed):
Cancer of the liver (only if portal circulation is obstructed);
Echinococcus (hydatids) of the liver (only if portal circulation is obstructed);
Suppurative pylephlebitis (only if portal circulation is obstructed).
Pylethrombosis (only if portal circulation is obstructed).

(2) In cancer of the pancreas (only if portal circulation is obstructed);

(3) In tumors of the uterus and ovaries (sometimes and enormous).

NODULES ON THE LIVER.

These occur in :

(1) Common cirrhosis of the liver (small nodules), &c.
(2) Syphilis of the liver (gummata) :
(3) Cancer of the liver (large nodules) :
(4) Echinococcus (hydatids) of the liver (vesicles).

ENLARGEMENT OF THE LIVER.

This occurs in :

(1) Active hyperaemia of the liver :
(2) Passive congestion of the liver :
(3) Suppurative hepatitis :
(4) Common cirrhosis, in the early stage :
(5) Hypertrophic cirrhosis :
(6) Gastro-duodenal catarrh :
(7) Cholelithiasis :
(8) Syphilis of the liver :
(9) Cancer of the liver (sometimes) :
(10) Echinococcus of the liver :
(11) Fatty liver :
(12) Amyloid liver.

ATROPHY OF THE LIVER.

This occurs in :

(1) Simple atrophy :
(2) Common cirrhosis :
(3) Acute yellow atrophy :
(4) Cancer of the liver (sometimes).

DROPSY.

Dropsy is a general term indicating an abnormal accumulation of serous fluid in a cavity of the body or in the meshes of areolar tissue anywhere.

Anasarca is a term used to indicate general dropsy of all the areolar tissues of the whole body.

Oedema is a term used to indicate local dropsy of a part of the body or of any solid organ, but does not refer to cavities.

CHARACTERISTIC DROPSY.

Dropsy of the Eyelids first and then of the feet (oedema) occurs in kidney diseases.

Dropsy of the feet (oedema) first occurs in heart diseases.

Dropsy of the peritoneum (ascites) first occurs in liver diseases, cancer of the pancreas, uterine and ovarian tumors, tuberculosis of the peritoneum (tabes mesenterica), &c.

Dropsy of the lateral ventricles of the brain (hydrocephalus) is congenital or acquired (due to tuberculosis).

Hydrophthalmia (dropsy of the eye): this is an increase in the fluid contents of the eye and may be due to inflammation.

Dropsy of the antrum occurs in chronic inflammation of the antrum.

Dropsy of the pericardium (hydropericardium) occurs in chronic pericarditis.

Dropsy of the pleurae (hydrothorax) occurs in chronic pleurisy, some heart diseases, &c.

Dropsy of a joint (hydrops articuli, hydrarthrosis) occurs in chronic arthrites (synovitis).

Dropsy of the pelvis of the kidney (hydronephrosis) is due to a collection of urine in the pelvis of the kidney, caused by obstruction in the ureter.

Dropsy of the Spine (spina bifida) is congenital.

Dropsy of the Testicle (hydrocele of the tunica vaginalis or of the cord), may be congenital or acquired. The cause is not known.

Dropsy of the uterus (hydrometra).

Dropsy, Paralytic. This occurs in a paralyzed part of the body.

Dropsy, Spurious. This is due to an obstruction of the natural outlet of a secreting organ.

Local oedema of the skin often occurs over deep seated pus, as in appendicitis.

ARGYLL-ROBERTSON PUPIL.

(Da Costa.)

This is a reflex irido-plegia, i. e., a small pupil that does not contract to light, but does contract during accommodation for near objects. Vision is generally normal.

It is caused by a lesion between the corpora quadrigemina and the oculo-motorius centre.

Diseases: It occurs in

Locomotor Ataxia:

Progressive paralysis of the insane, &c.

ARCUS SENILIS.

(Da Costa.)

This is a yellowish ring around the cornea and consists of two varieties, the true and the false.

True Arcus Senilis has a yellowish ring, blurred outlines, and a cloudy cornea.

Significance: It signifies fatty degeneration and tissue decay somewhere.

False Arcus Senilis has a yellowish ring, well defined outlines, and a clear and bright cornea. It occurs in elderly persons.

Significance: It signifies calcareous degeneration.

CHEYNE-STOKES RESPIRATION.

(Da Costa.)

This is a form of dyspnoea that consists in inspirations at first short, then deeper and more and more labored, until the paroxysm is at its height; then becoming shorter, and more and more shallow, until the breathing is suspended. There is then a pause lasting from ¼ to 1 minute, when the respiration begins again in the same manner, first faint, then a little stronger, then still stronger until it reaches its height, when it

again subsides in a descending scale, to end in the same standstill. It is very unfavorable.

It is caused by the supply of arterial blood being cut off from the brain or respiratory centre in the medulla.

Diseases. It occurs in

Pulmonary diseases (rare):
Fatty heart:
Disease of the aorta:
Tubercular meningitis:
Apoplexy and affections compressing the medulla:
Uraemia.

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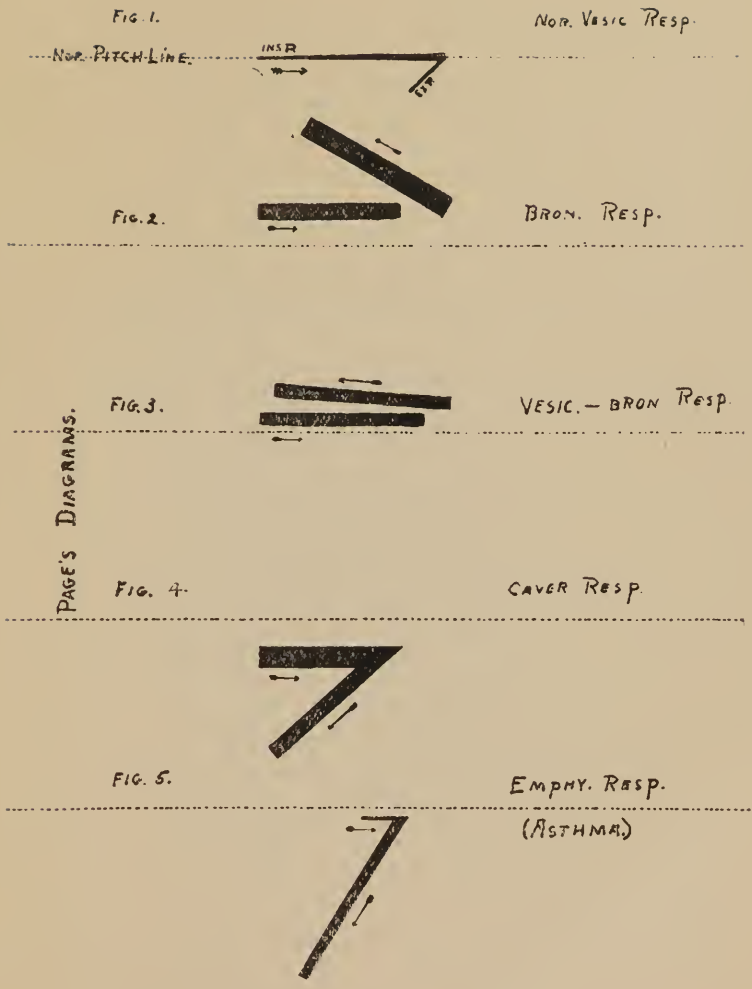

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